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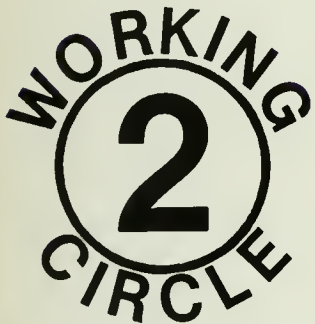
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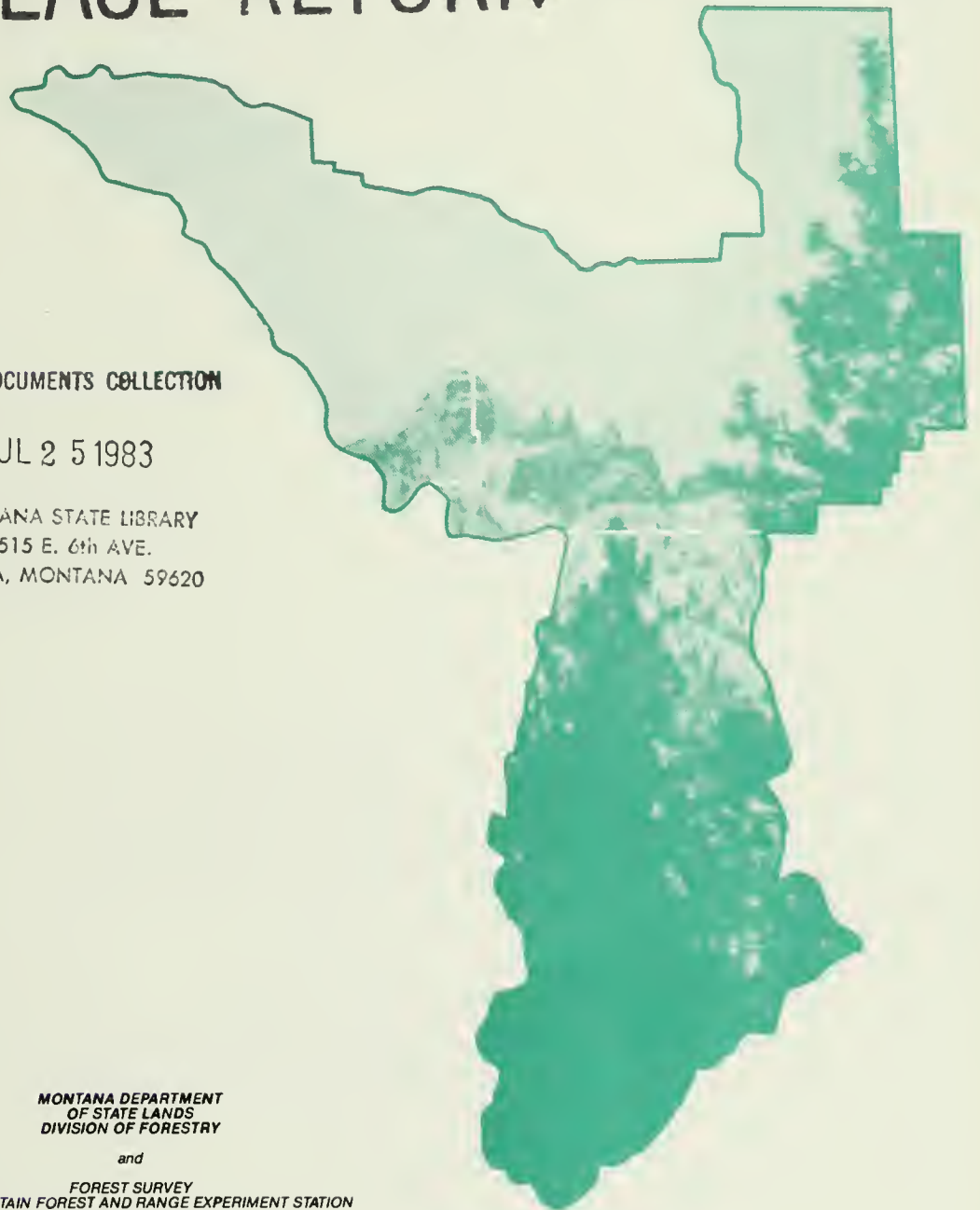
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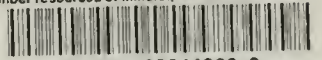
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# **TIMBER RESOURCES of MINERAL, MISSOULA and RAVALLI COUNTIES**

**APRIL, 1983**

**MONTANA DEPARTMENT OF  
STATE LANDS  
FORESTRY DIVISION  
2705 SPURGIN ROAD  
MISSOULA, MONTANA 59801**

**and**

**FOREST SURVEY  
INTERMOUNTAIN FOREST AND RANGE EXPERIMENT STATION  
REGION 1, USDA FOREST SERVICE**





## ABSTRACT

Timber inventory data collected in 1978 for the 887,700 acres of state and private commercial timberlands in Working Circle 2, which includes Mineral, Missoula and Ravalli counties, estimated a total growing stock volume of 1.4 billion net cubic feet. Sawtimber volume was estimated to be 4.3 billion net board feet Scribner. Approximately 708,600 acres of grazable commercial timberland, of which 591,000 acres are in good or excellent condition, existed on state and private lands within the working circle. In 1978 the carrying capacity of this acreage was estimated to be 86,600 animal unit months.

The area surveyed was found to be very favorable for timber production. The average potential productivity was found to be 73 cubic feet per acre per year. Based on a timberland quality class analysis, 62 percent of the softwood commercial timberlands in Working Circle 2 were rated as excellent or good for producing timber.

It may not be possible to continue the current rate of harvesting on private land indefinitely under the existing level of timber management. Silvicultural treatment opportunities exist on 70 percent of the commercial timberland. Employment of these treatments would dramatically increase the growth rates and thereby possibly eliminate any potential timber supply reduction from private land. The extent to which these opportunities are realized, beginning immediately, will determine the amount of timber available for harvest in the future.



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## PREFACE

This publication summarizes the findings of a timber resource inventory conducted in Mineral, Missoula, and Ravalli counties (Working Circle 2). It is the third in a series of forest inventory reports. Each report displays and analyzes inventory data for a different portion of the state. A statewide report will subsequently be published by the Intermountain Forest and Range Experiment Station in cooperation with the Montana Department of State Lands (DSL), Forestry Division.

The inventory of Working Circle 2 began in November, 1977, under the authority of an existing cooperative agreement between the Intermountain Forest and Range Experiment Station, Region 1 of the USDA Forest Service, and the Montana Department of Natural Resources and Conservation, Forestry Division. Under the agreement, the Forestry Division, transferred to the Department of State Lands in 1981, would supervise the collection of forest inventory data on all lands in Working Circle 2 except those administered by the USDA Forest Service or the USDI Bureau of Indian Affairs and Bureau of Land Management. The USDA Forest Service would provide technical assistance and 60 percent of the funding for the project. The state of Montana would provide the remaining 40 percent.

Aerial photo interpretation began in December, 1977, and was concluded in June of 1978. Field data collection from 400 forested plots began in May and continued until the last plot was measured in December, 1978.

Readers should note that because the data was rounded off to reach the numbers used in this report, the column and row totals in some tables may not be the exact sum of the individual cells.



## ACKNOWLEDGEMENTS

This project could not have been completed without the willing assistance of numerous groups. DSL, the Intermountain Forest and Range Experiment Station, and Region 1, Cooperative Forestry and Pest Management jointly wish to acknowledge the following agencies, organizations, and individuals for their contributions and cooperation:

Montana Department of Natural Resources and Conservation  
Soil Conservation Service  
Agricultural Stabilization and Conservation Service  
Bitterroot National Forest  
Flathead National Forest  
Lolo National Forest  
Clerk and Recorder's offices in Mineral, Missoula, and Ravalli counties  
Assessors' offices in Mineral, Missoula, and Ravalli counties  
Montana Department of Fish, Wildlife and Parks  
Burlington Northern, Inc.  
Champion International Corp.  
USDI Bureau of Indian Affairs  
USDI Bureau of Land Management  
Local landowners who granted access to their lands.

For collecting inventory data, DSL recognizes the forest inventory crew, which included: supervisor Brian Long; inventory foresters Jim Huter, Steve Wallace, Dave Remington, Pete Metzmaker, and Bob Dillon; inventory technicians Kurt Gelderman, Mark Hannah, Steve Jorgenson, Randy Pearson, and Jeff Rupkalvis; and secretary Caroline Flink. For consulting, adopting, and developing special inventory procedures, DSL recognizes: Hal Hunter and Frank Kirschten of the Soil Conservation Service, and Vince Frezzo of the Forestry Division (forest land range inventory); Jeff Jahnke and Paul Klug of the DSL (silvicultural treatment opportunities inventory); Terry Lonner of the Montana Department of Fish, Wildlife, and Parks (wildlife use inventory; and Bill Fischer of the Forest Service (fuel loading inventory). DSL also recognizes: Brian Long and Bob Dillon of the Forestry Division for writing this report; Diane Smith for editing it; Bob Dillon and Kurt Gelderman of the Forestry Division for the photographs used in this report; and the Montana Department of Administration, Publications and Graphics Bureau for helping with the graphics, layout, and printing. Earl Salmonson and Don Artley of the Forestry Division provided direction for the project.

## ABBREVIATIONS

AUM	animal unit month
BAF	basal area factor
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
CFL	Commercial forest land
d.b.h.	diameter at breast height
DNRC	Montana Department of Natural Resources and Conservation
DLS	Montana Department of State Lands
MAI	mean annual increment
MBF	thousand board feet
MBFS	thousand board feet Scribner
MMBF	million board feet
NCFL	noncommercial forest land
NPS	National Park Service
SCS	Soil Conservation Service
USDA	U. S. Department of Agriculture
USDI	U. S. Department of the Interior
USFS	U. S. Forest Service

## INTRODUCTION

### Geographical Overview

Working Circle 2 has a wide range of topographic features. The Mission and Swan Ranges in northern Missoula County, as well as the Bitterroot Range in western and southern Ravalli County, were scoured by glaciers and left with jagged peaks and U-shaped valleys. The Bitterroot Range in Mineral County was also glaciated, however, the effects were less dramatic. The Bitterroot, St. Regis, and Swan Rivers all have their origins in the mountains of Working Circle 2. The Clark Fork and the Blackfoot Rivers flow in from the east and meet near Missoula, and are joined first by the Bitterroot and later the St. Regis Rivers. The Swan River flows north out of Missoula County, through Swan Lake, and into Flathead Lake at Big Fork. Figure 1 displays the major geographic features.

### Mineral County

Mineral County consists of a long, narrow valley bordered by three western Montana mountain ranges. On the west, the Bitterroot Range is the boundary between Mineral County and the state of Idaho. The Coeur d'Alene Mountains and the Ninemile Divide form the county's northern and eastern boundaries respectively. In the valley, the St. Regis River meets the Clark Fork at St. Regis and together they flow into Sanders County to meet the Flathead River.

Superior, the county seat, is home for 29 percent of Mineral County's 3,674 residents. The county's one major sawmill has an annual output of 80 million board feet (MMBF), and six small sawmills produce another 6 MMBF. There are also two post and pole operators, two cedar mills, and one log home producer. The largest ponderosa pine in Montana is along Fish Creek in Mineral County, which indicates the county's potential to produce timber.

# GEOGRAPHICAL FEATURES of WORKING CIRCLE 2



## Missoula County

The terrain in Missoula County varies from the abrupt glaciated mountains in the northeast to the more subdued ranges in the south. Broad valleys lie along some of the major rivers. Sediments from glacial Lake Missoula and tertiary deposits are common on low elevations and form the basis for productive sites. A small part of Missoula County extends across the Rattlesnake Mountains into the Flathead Indian Reservation. Missoula County has more state and private commercial forest land than any other county in Montana.

Of the 75,432 people in Missoula County, 86 percent live in and around Missoula, the county seat. Missoula is the home of the University of Montana, the Northern Forest Fire Laboratory and the headquarters of the Northern Region of the Forest Service. There are 4 major sawmills in Missoula County which together produce over 250 MMBF of lumber, and 15 small sawmills which produce another 5 MMBF annually (see table 121). The biggest plywood mill in the Rocky Mountains, with an annual output of 300 million square feet,\* is also located in Missoula County. In addition there are 2 particle board plants producing 100 million square feet,\*\* a paper mill that produces approximately 600 thousand tons, a log home builder who produces 500 houses per year, three post and pole operators, and a cedar mill.

\*on a 3/8" basis

\*\*on a 3/4" basis

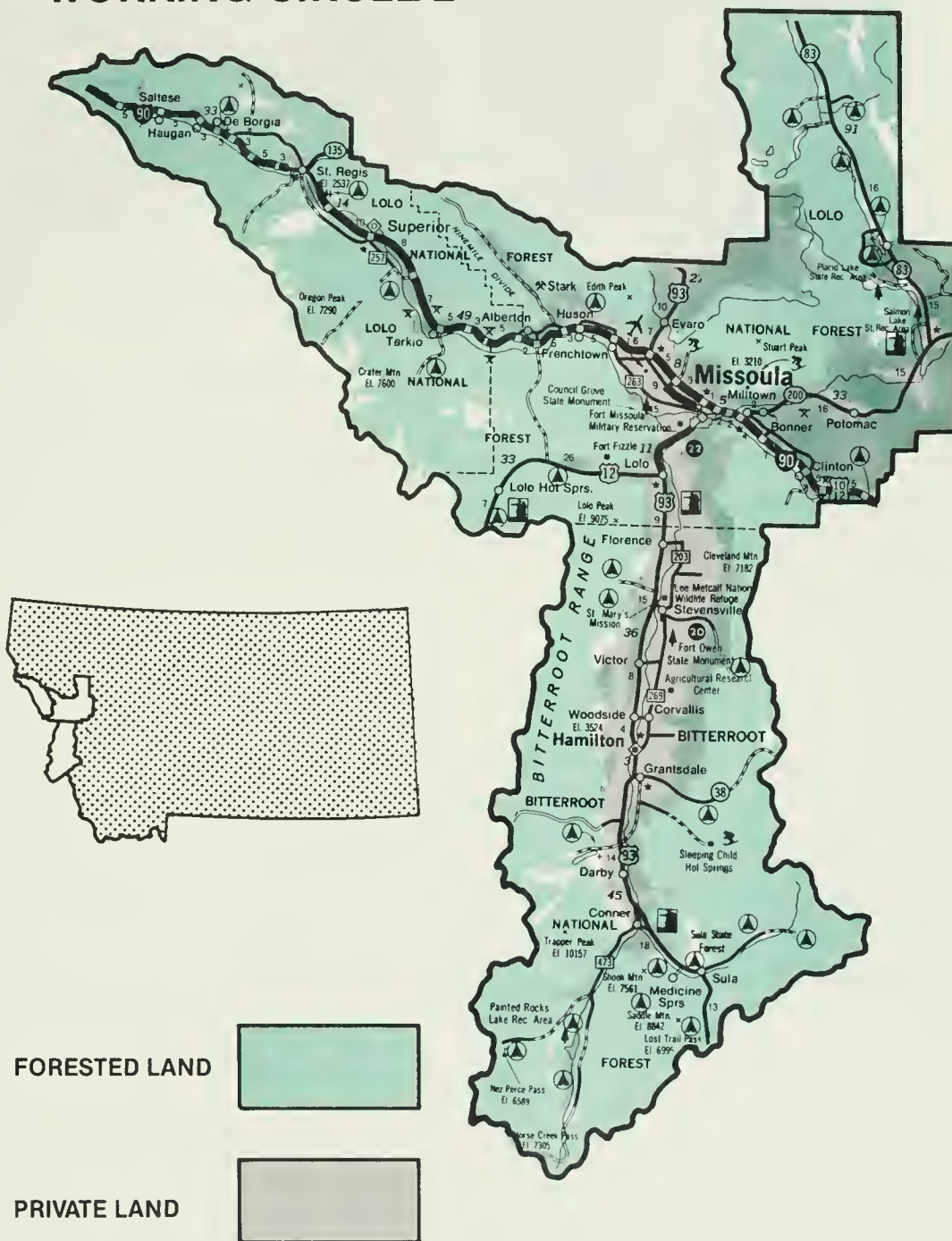


## Ravalli County

The striking Bitterroot Range is the border between Ravalli County and Idaho, and provides beautiful scenery and recreation opportunities for residents and visitors alike. The less spectacular Sapphire Mountains and Anaconda Range make up the eastern border. The Bitterroot River tumbles out of the mountains at the south end of Ravalli County and flows north past historic Fort Owen and St. Mary's Mission. The Lee Metcalf National Wildlife Refuge hosts migrating waterfowl such as swans, geese, and ducks, and is the home for nonmigratory animals including deer, pheasants, and birds of prey.

Ravalli County is one of the fastest growing counties in the state, largely because the northern part of the county is so popular with people who work in Missoula but want to live in the country. Twelve percent of the 22,427 Ravalli County residents live in Hamilton, the county seat. The two major sawmills produce 70 MMBF annually, and seven small sawmills add another 10 MMBF. There are nine log home builders who together produce 500 houses, and eight post and pole operators.

# FOREST COVER and OWNERSHIP MAP of WORKING CIRCLE 2



## Forest Types

A description of each forest type sampled in Working Circle 2 follows. These descriptions may not be the same for all working circles in the state.

Because more than one tree species can occur within a given forest type, those species that exhibited the largest number of live trees (plurality of stocking) at a sampled location determined the forest type. Individual trees were ranked according to their relative dominance in the plot. In those cases where trees had overstocked a site, smaller or less-dominant trees were not counted. Unless a stand of trees was lightly stocked with poletimber or sawtimber, seedlings and saplings were seldom considered when designating a forest type.

Portions of Working Circle 2 contain many of the Pacific Coast forest species which are less common or absent elsewhere in the state. These species, which include mountain hemlock (Tsuga mertensiana), western redcedar (Thuja plicata), grand fir (Abies grandis), western white pine (Pinus monticola), and western yew (Taxus brevifolia), receive the abundant precipitation and comparatively moderate temperatures they need to survive from moist maritime air masses that pass over the area on their way inland from the Pacific Coast (Arno 1979).





## Douglas-fir Type

### Important Statistics

CFL Area (thousand acres)	Percent of CFL Total
399.9	45.2
Net Volume	
533,867 Mft <sup>3</sup>	38.0
1,676,407 MBFS	39.2

The Douglas-fir forest type covers more acres and contains more timber volume than any other forest type in Working Circle 2. This type was sampled over a wide range of elevations, from 3,200 feet to 6,300 feet, and was found on all aspects. Ponderosa pine (Pinus ponderosa variety ponderosa), lodgepole pine (Pinus contorta variety latifolia), and western larch (Larix occidentalis) were most commonly found growing with Douglas-fir (Pseudotsuga menziesii variety glauca).



## Ponderosa Pine Type

### Important Statistics

CFL Area (thousand acres)	Percentage of CFL Total
187.8	21.2
Net Volume	
238,780 Mft <sup>3</sup>	17.0
860,479 MBFS	20.1

The ponderosa pine forest type was sampled at elevations of 2,700 to 5,700 feet. Nearly pure stands are most often found on sites where ponderosa pine is the climax species or on the warmer, well-drained Douglas-fir climax sites. Douglas-fir was found to be the most common associate of ponderosa pine.





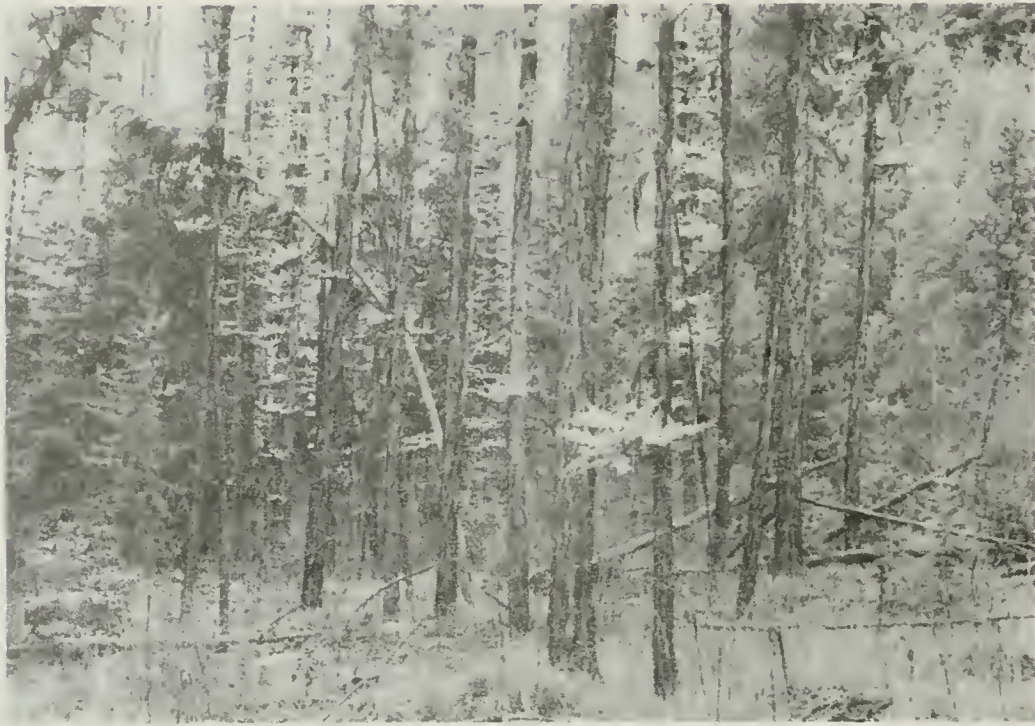
### Lodgepole Pine Type

#### Important Statistics

CFL Area (thousand acres)	Percentage of CFL Total
119.6	13.5
Net Volume	
282,215 Mft <sup>3</sup>	20.1
452,767 MBFS	10.6

Stands of lodgepole pine, typically homogeneous, can be found growing on most forest sites except within certain timberline whitebark pine (Pinus albicaulis) habitat types, ponderosa pine habitat types, and the warmer, drier Douglas-fir habitat types. Stands of lodgepole pine were sampled at elevations from 2,600 feet to 6,400 feet.

Generally, the presence and abundance of lodgepole pine reflects the fire history of the area. After a fire or certain harvesting practices, this species will often regenerate into dense stands which tend to stagnate.



### Western Larch Type

#### Important Statistics

CFL Area (thousand acres)	Percentage of CFL Total
66.1	7.4
Net Volume	
90,097 Mft <sup>3</sup>	6.4
333,589 MBFS	7.8

The western larch forest type was sampled at elevations from 2,900 to 5,600 feet. The presence of western larch, like lodgepole pine, reflects the fire history of the area. Western larch is the least shade tolerant commercial tree species in the northern Rockies (Schmidt et al., 1976). To regenerate harvested larch stands, even-aged management techniques including clearcutting, shelterwood, and seed-tree methods are used to create conditions similar to those that follow wildfires.

Western larch always occurs as a seral component of the forest and can be found growing over a wide range of ecological conditions. The most common associate was Douglas-fir, with lesser amounts of lodgepole pine, ponderosa pine, grand fir, and spruce (primarily Picea engelmannii) also occurring in the type.





### Subalpine Fir-Spruce Type

#### Important Statistics

CFL Area (thousand acres)	Percentage of CFL Total
55.1	6.2
Net Volume	
123,819 Mft <sup>3</sup>	8.8
454,361 MBFS	10.6

Commercial stands of the subalpine fir-spruce type were sampled at elevations from 4,600 to 6,200 feet. In western Montana many tree species can be found growing within this type. The most common associates were Douglas-fir and western larch. On the drier more exposed sites, stands classified as subalpine fir-spruce contain very few, if any, spruce (Picea species) trees.

Forest stands of this type tend to be uneven aged and heavily stocked under natural conditions. Subalpine fir (Abies lasiocarpa) is highly shade tolerant and grows in cold, moist climates. Often a slow growing tree species, subalpine fir is susceptible to fire, wind damage, and heart rot. Consequently, individual trees of this species rarely live longer than 250 years. Due to its susceptibility to heart rot and the brittle nature of its wood, subalpine fir is not a preferred timber species. However, it is growing in importance as logging moves higher into the mountains.



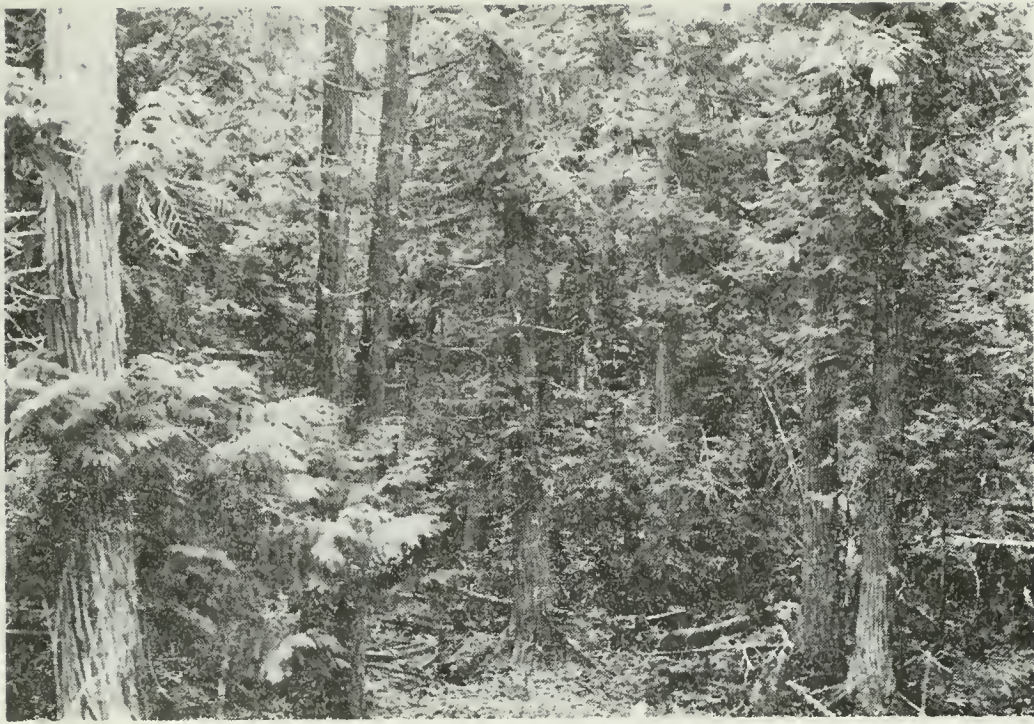
## Spruce Type

Important Statistics	
CFL Area (thousand acres)	Percentage of CFL Total
28.1	3.1
Net Volume	
84,656 Mft <sup>3</sup>	6.0
324,451 MBFS	7.6

In Montana the most common species of spruce is Engelmann spruce (Picea engelmannii), although in many stands Engelmann spruce has hybridized with white spruce (Picea glauca). Occasionally a stand containing white spruce can be found (Pfister et al. 1977).

The spruce forest type was found in moist to wet areas with cool to cold climates. Spruce is commonly found growing in cool ravines, along streams and lakes, or in areas with a high water table. It also can be found growing at or near the timberline in association with whitebark pine (Pinus albicaulis) and subalpine fir. The tree species most often found growing with spruce in Working Circle 2 were western larch and lodgepole pine. Stands of this type were sampled at elevations from 3,500 to 5,600 feet.





#### Western Redcedar Type

##### Important Statistics

CFL Area (thousand acres)	Percentage of CFL Total
5.6	0.6
Net Volume	
18,804 Mft <sup>3</sup>	1.3
61,611 MBFS	1.4

Western redcedar is a valuable timber species primarily used for shakes or shingles. Stands are generally confined to bottomlands and northerly exposures between 2,000 and 5,000 feet on sites where annual precipitation is 32 inches or more (Pfister et al., 1977). The redcedar type in Working Circle 2 was sampled at an elevation of 4,400 feet.



#### Whitebark Pine Type

##### Important Statistics

CFL Area (thousand acres)	Percentage of CFL Total
2.9	0.3
Net Volume	
7,579 Mft <sup>3</sup>	0.5
21,604 MBFS	0.5

The whitebark pine forest type occurs at the upper limits of commercial forest land. Subalpine fir, spruce, lodgepole pine, and, occasionally, mountain hemlock (Tsuga mertensiana) are all commonly associated with whitebark pine. This type is often found above or adjacent to the subalpine fir-spruce forest type, on sites too harsh or exposed for subalpine fir to dominate. A commercial stand was sampled at an elevation of 6,700 feet.

Whitebark pine grows slowly and can live for many years. Trees 400 to 500 years old are not uncommon. Whitebark pine is not an important commercial species in Working Circle 2.





## Grand Fir Type

### Important Statistics

CFL Area (thousand acres)	Percentage of CFL Total
2.5	0.2
Net Volume	
562 Mft <sup>3</sup>	*
656 MBFS	*

The grand fir forest type is commonly found on relatively moist sites that are too temperate to be dominated by subalpine fir. The most common associated species is Douglas-fir. The type was sampled at an elevation of 4,700 feet. Stands may be found up to 5,500 feet in this working circle (Pfister et al. 1977).

\*Indicates less than 0.05 percent.



## Juniper Type

### Important Statistics

CFL Area (thousand acres)	Percentage of CFL Total
0.7	0.1
Net Volume	
60 Mft <sup>3</sup>	*
248 MBFS	*

The juniper forest type grows on dry, rocky sites over a wide range of elevations. The commercial stand was sampled at 5,300 feet. Most juniper (Juniperus scopulorum) stands are found on sites that are not capable of producing 20 cubic feet of wood per acre per year under natural conditions. Commercial forest land classified into the juniper forest type contain Douglas-fir and/or ponderosa pine. In some parts of the state, juniper is used for fence posts and firewood. The volumes shown for all forest types do not include juniper because it is not considered a commercial species in Montana.

\*Indicates less than 0.5 percent.





### Cottonwood Type

#### Important Statistics

CFL Area (thousand acres)	Percentage of CFL Total
13.9	1.5
Net Volume	
20,511 Mft <sup>3</sup>	1.4
80,496 MBFS	1.8

Stands of cottonwood (Populus trichocarpa) grow along rivers and streams throughout the working circle. Most of these stands occur along the Clark Fork and Bitterroot Rivers. Commonly associated species are spruce and ponderosa pine in Working Circle 2.



## Aspen Type

Important Statistics	
CFL Area (thousand acres)	Percentage of CFL Total
1.3	0.1
Net Volume	
481 Mft <sup>3</sup>	*
1,160 MBFS	*

In Working Circle 2, aspen (Populus tremuloides) stands are usually small and occur adjacent to or among conifer stands. Stands were sampled at elevations ranging from 3,200 to 3,600 feet.

Periodic wildfires seem necessary for aspen stands to perpetuate (Pfister 1977). In areas where wildfires have successfully been suppressed, aspen stands seem to be succeeding towards conifer stands.

Aspen is not an important commercial species in Working Circle 2.

\*Indicates less than 0.05 percent.



## Inventory Procedures

The timber resource inventory was designed to provide inventory data for the individual working circles in Montana and the state as a whole. Because reliable county data was desired in Working Circle 2, a large number of field plots were sampled. This allowed the data to be stratified further to provide better information at the county level.

Forest inventory data was collected on all private, state, county, municipal, and some miscellaneous federal lands in the working circle. These federal lands included USDI Fish and Wildlife Service lands, lands within national monuments, and other lands controlled by the U.S. Army Corps of Engineers and the USDI Bureau of Reclamation. The sampled area, which totalled 1.4 million acres, included forested and nonforested lands. (NOTE: Timber Resources on USDA Forest Service, USDI Bureau of Indian Affairs, USDI Bureau of Land Management, and National Park Service Lands were not inventoried).

Sample points were selected, measurements taken, and data analyzed through the following methods:

1. Initial area estimates were based on the classification of 11,300 sample points systematically placed on the latest aerial photographs available. The dates of these photos ranged from 1955 to 1976; most were 1972 photos. The sample points were summarized and grouped into strata for subsequent field sampling. The photo points, adjusted to meet known land areas, were used to compute area expansion factors for the field stratum means.

2. Land classification and estimates of timber characteristics and volume were based on observations and measurements recorded at 482 ground sample locations. Sample trees were selected using a 10-point cluster that included fixed plots (1/300 acre) for trees less than 5.0 inches d.b.h. and variable plots (40 BAF) for trees 5.0 inches d.b.h. or larger.

3. All photo and field data was sent to the Intermountain Experiment Station in Ogden, Utah, to be punched onto computer cards and stored for machine computing, sorting, and tabulation. Computerized edits were sent to the inventory crew for corrections. Final estimates were based on statistical summaries of the data.

Data reliability is listed in Appendix 1.



## MAJOR INVENTORY FINDINGS

### The Timber Resource

The total sampled area in Working Circle 2 was 1.4 million acres of which 883,500 acres (63 percent) were classified as commercial timberland. About 54 percent of the sampled timberland was owned by forest industries, 32 percent was owned by other private owners, and 14 percent was state-owned. Douglas-fir was found to be the dominant forest type, covering 45 percent of the commercial timberland. Growing stock net volume was estimated to be 1.4 billion cubic feet and sawtimber volume was estimated to be 4.3 billion board feet Scribner. Douglas-fir and ponderosa pine trees contained 58 percent of the board foot volume and 52 percent of the cubic foot volume. Annual growing stock net growth totaled 26.9 million cubic feet and sawtimber totaled 90.1 million board feet. Annual mortality was estimated to be 10.2 million cubic feet or 27.8 million board feet. The average acre of commercial timberland has the potential to produce 73 cubic feet per acre per year. About 83 percent of the timberland had the potential to produce 50 or more cubic feet per acre per year.

#### Area By Ownership Group

Table 1 shows the acreage and percentage of land in Working Circle 2 owned or administered by the different owners. As this table shows, public agencies owned or administered 69 percent of the land. The USDA Forest Service administers the largest portion of this public land, as well as most of the forested land in the working circle.

Table 1. Total land area by owner, Working Circle 2, (acres).

Owner	Acreage	Percentage of Total
Public:		
USDA Forest Service	2,433,374	61.5
USDI Bureau of Land Management	25,962	0.7
USDI Bureau of Indian Affairs	94,392	2.4
Miscellaneous Federal	2,692	0.1
State	164,079	4.1
County and Municipal	2,075	0.1
Subtotal	2,722,575	68.9
Private:		
Forest Industry	530,323	13.4
Other Private	703,844	31.1
Subtotal	1,234,167	31.1
Total Land Area	3,956,742	100.0

The proportion of the sampled lands--private, state, county, municipal, and miscellaneous federal--owned or administered by different ownership groups is shown in figure 3. The total sampled area was 1.4 million acres which included nonforest land as well as forest.

Of the commercial forest land sampled, about 54 percent, or 478,000 acres, was owned by forest industries (see table 2). Another 20 percent was owned by farmers and ranchers (see figure 4). The State of Montana owned an additional 14 percent of the commercial forest land sampled.

Table 2. Area of commercial and other timberland by owner, Working Circle 2, (thousand acres).

Owner	Commercial Timberland	Other Timberland	All Timberland	Percentage of Total
	-----thousand acres-----			
Public:				
State	125.8	0.5	126.3	14.2
Miscellaneous federal	0.3	**	0.3	*
County and municipal	0.1	-	0.1	*
Subtotal	126.3	0.5	0.1	14.2
Private:				
Forest industry	478.3	1.0	479.2	54.0
Farmer-rancher	172.6	2.0	174.6	19.7
Other private-corporate	29.6	0.2	29.8	3.4
Other private-individual	76.8	0.5	77.3	8.7
Subtotal	757.3	3.7	761.0	85.8
Total	883.5	4.2	887.7	100.0

\*Indicates less than 0.05 percent.

\*\*Indicates less than 50 acres.



Figure 3. Proportion of the total sampled area (forest and nonforest) by ownership group, Working Circle 2.

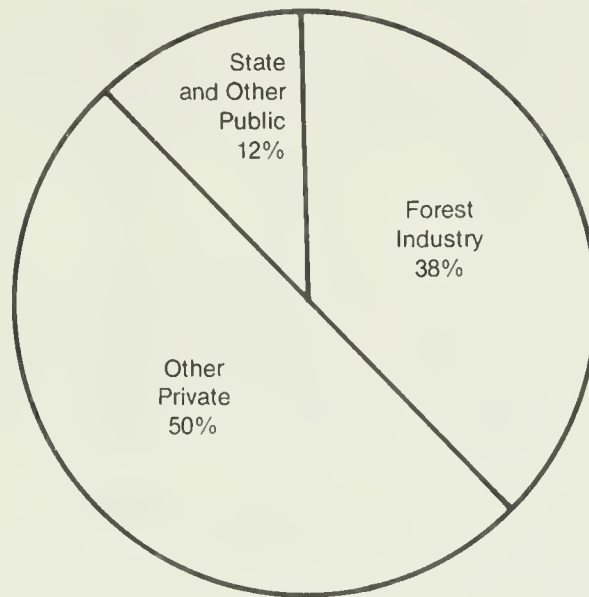
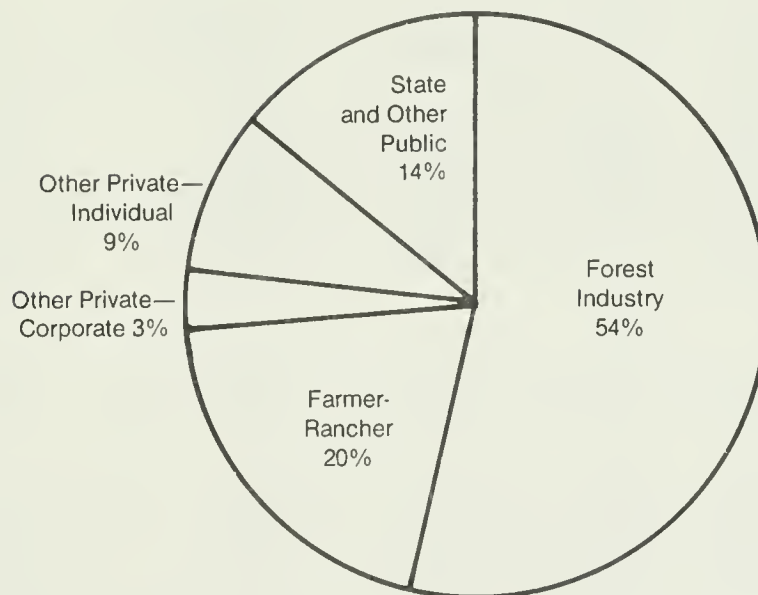


Figure 4. Proportion of the sampled commercial timberland area by ownership class, Working Circle 2.



## Forest Type Acreage

Douglas-fir and ponderosa pine forest types together comprised 66 percent of the total commercial forest land acreage. The lodgepole pine type comprised an additional 14 percent. These three forest types made up 80 percent of the commercial timberland (see table 3).

## Volume Estimates

The Douglas-fir, ponderosa pine, and lodgepole pine forest types contained 75 percent of the total growing stock cubic foot volume and 70 percent of the total sawtimber board foot volume occurring on sampled land in Working Circle 2 (see tables 4 and 5).

About 55 percent of the total sampled volume in the working circle was forest industry owned. About 30 percent was other private timberlands. These percentages apply to both board feet and cubic feet volumes.

Board foot volume by species is compared by ownership groups in table 7. As shown, forest industry-owned lands had 79 percent of the spruce volume, 71 percent of the western larch volume, and 56 percent of the Douglas-fir volume. Other privately-owned timberlands had 46 percent of the ponderosa pine volume in this working circle.

The volume by species tables also show Douglas-fir, lodgepole pine, and ponderosa pine made up 74 percent of the total cubic foot volume in the working circle. On a board foot basis Douglas-fir, ponderosa pine, and western larch had 72 percent of the total volume.

The average volume per acre for all sampled lands was estimated to be 4,800 board feet Scribner (see Appendix 3, table 102).

Table 3. Area of commercial timberland by forest type and ownership group, Working Circle 2, (thousand acres).

Forest Type	Ownership Group			Total	Percentage of Total
	State and Other	Public Forest Industry	Other Private		
	-----thousand acres-----				
Douglas-fir	67.3	229.7	102.9	399.9	45.3
Ponderosa pine	28.8	65.2	93.8	187.8	21.3
Lodgepole pine	17.3	60.4	41.8	119.6	13.5
Western larch	5.8	50.2	10.1	66.1	7.5
Subalpine fir-spruce	2.3	49.9	2.9	55.1	6.2
Spruce	2.3	16.5	9.2	28.1	3.2
Western redcedar	0.2	2.7	2.7	5.6	0.6
Whitebark pine	0.3	-	2.6	2.9	0.3
Grand fir	0.2	0.2	2.1	2.5	0.3
Juniper	-	0.1	0.6	0.7	0.1
Softwood types	124.7	475.0	268.6	868.3	98.3
Cottonwood	0.9	3.2	9.7	13.9	1.6
Aspen	0.7	0.1	0.6	1.3	0.1
Hardwood types	1.6	3.3	10.3	15.2	1.7
All forest types	126.3	478.3	279.0	883.5	100.0

Table 4. Net volume of growing stock on commercial timberland by forest type and ownership group, Working Circle 2, (thousand cubic feet).

Forest Type	Ownership Group			Total	Percentage of Total
	State and Other	Public Forest Industry	Other Private		
	-----thousand cubic feet-----				
Douglas fir	102,882	294,252	136,733	533,867	38.1
Ponderosa pine	41,517	69,269	127,994	238,780	17.0
Lodgepole pine	45,580	150,131	86,504	282,215	20.1
Western larch	11,544	60,474	18,078	90,097	6.4
Subalpine fir-spruce	2,659	119,185	1,974	123,819	8.8
Spruce	7,510	49,475	27,671	84,656	6.1
Western redcedar	731	10,125	7,948	18,804	1.4
Whitebark pine	834	-	6,744	7,579	0.6
Grand fir	52	49	461	562	-
Juniper	4	7	49	60	-
Softwood types	213,314	752,968	414,158	1,380,439	98.5
Cottonwood	758	10,520	9,233	20,511	1.5
Aspen	340	18	123	481	-
Hardwood types	1,099	10,538	9,356	20,993	100.0
All forest types	214,413	763,506	423,514	1,401,432	100.0

\*Indicates less than 0.05 percent.

Table 5. Net volume of sawtimber on commercial timberland by forest type and ownership group, Working Circle 2, (thousand board feet Scribner).

Forest Type	Ownership Group				Percentage of Total
	State and Other Public	Forest Industry	Other Private	Total	
	-----thousand board feet-----				
Douglas fir	340,856	919,896	415,655	1,676,407	39.3
Ponderosa pine	159,411	240,921	460,146	860,479	20.2
Lodgepole pine	109,262	181,902	161,603	452,767	10.6
Western larch	39,513	234,500	59,576	333,589	7.8
Subalpine fir-spruce	3,089	448,911	2,361	454,361	10.6
Spruce	20,109	214,435	89,907	324,451	7.6
Western redcedar	1,563	43,045	17,003	61,611	1.4
Whitebark pine	2,378	-	19,225	21,604	0.5
Grand fir	61	57	538	656	*
Juniper	16	30	202	248	*
Softwood types	676,259	2,283,697	1,226,216	4,186,173	98.1
Cottonwood	3,055	40,130	37,310	80,496	1.9
Aspen	581	76	504	1,160	*
Hardwood types	3,636	40,206	37,814	81,656	1.9
All forest types	679,895	2,323,903	1,264,030	4,267,828	100.0

Table 6. Net volume of growing stock on commercial timberland by species and ownership group, Working Circle 2, (thousand cubic feet).

Species	Ownership Group				Percentage of Total
	State and Other Public	Forest Industry	Other Private	Total	
	-----thousand cubic feet-----				
Douglas fir	82,910	249,094	125,408	457,412	32.6
Ponderosa pine	52,424	92,938	132,121	277,483	19.8
Lodgepole pine	43,650	173,319	80,576	297,544	21.2
Western larch	20,857	104,272	27,726	152,856	10.9
Subalpine fir	5,302	43,385	8,002	56,689	4.0
Spruce	5,602	81,306	24,333	111,241	7.9
Western redcedar	173	5,724	1,883	7,780	0.6
Whitebark pine	1,025	-	4,417	5,441	0.4
Grand fir	473	4,408	3,068	7,949	0.6
Western white pine	30	1,106	323	1,458	0.1
Total softwoods	212,446	755,551	407,857	1,375,853	98.2
Cottonwood	769	5,718	9,266	15,752	1.1
Aspen	1,198	76	6,391	7,665	0.5
Other hardwoods	-	2,161	-	2,161	0.2
Total hardwoods	1,967	7,955	15,657	25,579	1.8
Total all species	214,413	763,506	423,514	1,401,432	100.0

\*Indicates less than 0.05 percent.



Figure 5. Net Volume of softwood growing stock on commercial timberland by species and ownership group, Working Circle 2, (thousand cubic feet).

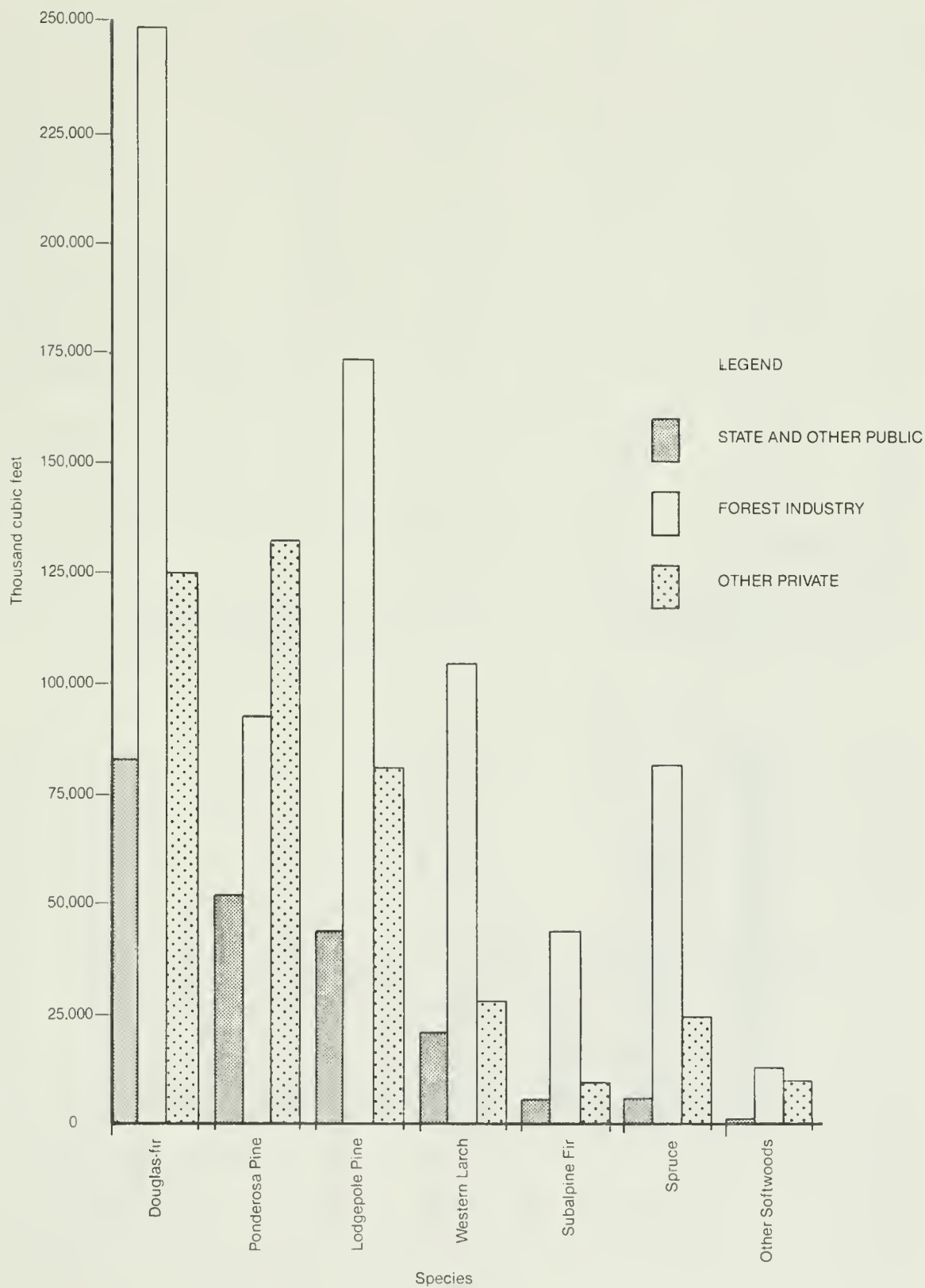


Figure 6. Net volume of softwood sawtimber on commercial timberland by species and ownership group, Working Circle 2, (thousand board feet Scribner).

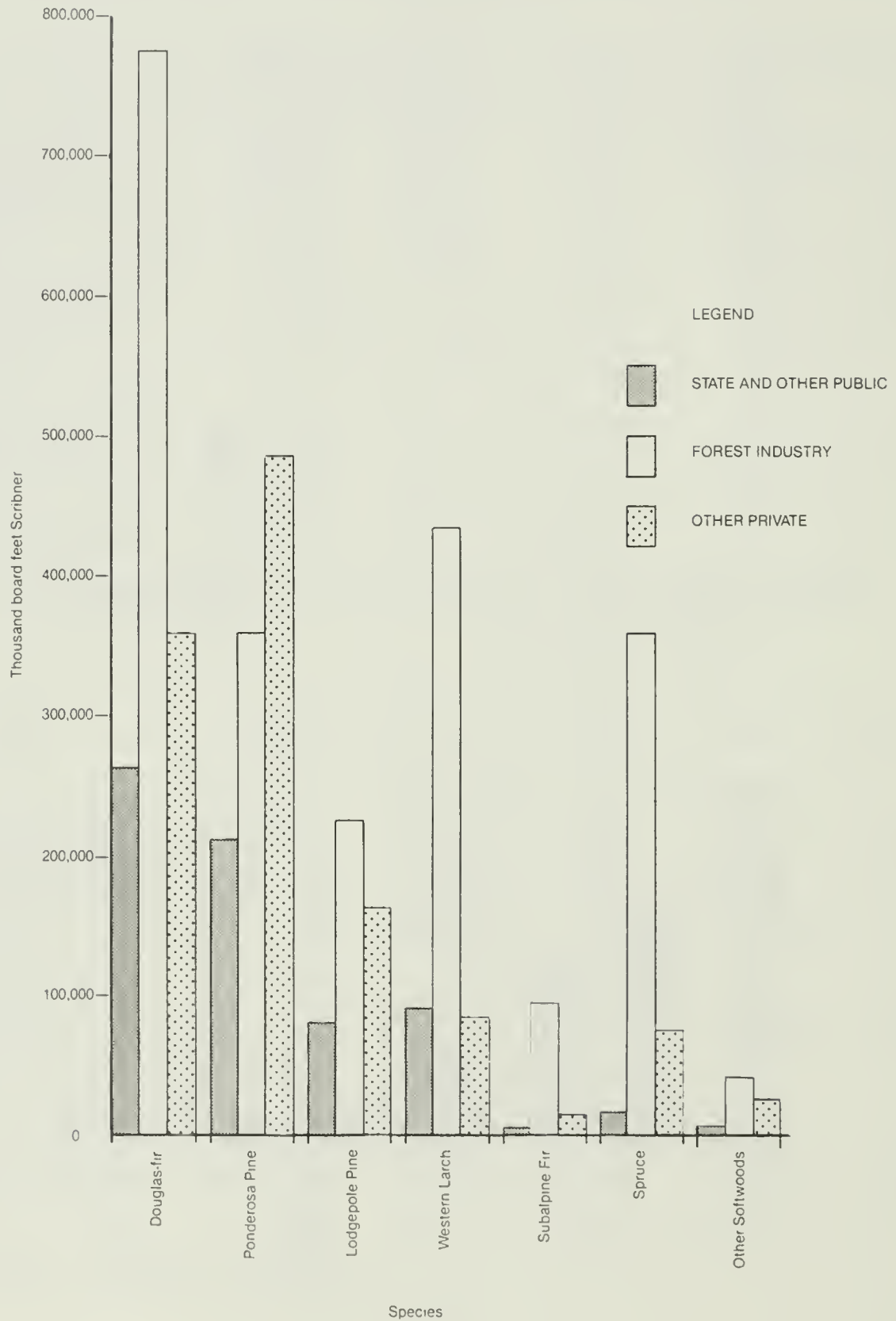


Table 7. Net volume of sawtimber on commercial timberland by species and ownership group, Working Circle 2, (thousand board feet Scribner).

Species	Ownership Group			Total	Percentage of Total
	State and Other Public	Forest Industry	Other Private		
	-----thousand board feet-----				
Douglas fir	263,789	776,832	359,227	1,399,848	32.8
Ponderosa pine	211,576	359,301	487,853	1,058,730	24.8
Lodgepole pine	80,190	225,414	163,739	469,342	11.0
Western larch	90,319	435,766	85,214	611,299	14.3
Subalpine fir	5,447	95,930	14,548	115,925	2.7
Spruce	17,462	359,822	76,664	453,949	10.6
Western redcedar	563	21,740	6,121	28,425	0.7
Whitebark pine	3,306	-	12,479	15,785	0.4
Grand fir	1,457	14,535	7,187	23,180	0.5
Western white pine	132	5,331	1,439	6,902	0.2
Total softwoods	674,241	2,294,672	1,214,472	4,183,385	98.0
Cottonwood	2,923	23,884	35,814	62,621	1.5
Aspen	2,732	-	13,744	16,475	0.4
Other hardwoods	-	5,347	-	5,347	0.1
Total hardwoods	5,654	29,231	49,558	84,444	2.0
Total all species	679,895	2,323,903	1,264,030	4,267,828	100.0

Table 8. Net annual mortality of growing stock on commercial softwood and hardwood forest types by ownership group, Working Circle 2, (thousand cubic feet).

Ownership Group	Forest Type		Total
	Softwood Types	Hardwood Types	
	-----thousand cubic feet-----		
State and Other Public	1,644	2	1,646
Forest Industry	6,202	2	6,204
Other Private	2,334	28	2,362
All Owners	10,180	32	10,212

Table 9. Net annual mortality of sawtimber on commercial softwood and hardwood forest types by ownership group, Working Circle 2, (thousand board feet Scribner).

Ownership Group	Forest Type		Total
	Softwood Types	Hardwood Types	
	-----thousand board feet Scribner-----		
State and Other Public	3,395	9	3,404
Forest Industry	17,814	8	17,822
Other Private	6,446	116	6,562
All Owners	27,655	133	27,788

## Growth and Mortality by Ownership Group

Growth Commercial timberlands on state and private lands in Working Circle 2 were growing at an annual rate of 26,904,000 net cubic feet or 90,134,000 net board feet Scribner (see tables 10 and 11). Over time, net growth will change depending on such factors as the forest's overall age, condition, mortality rates, and the amount of harvest.

Most of the cubic foot net growth--about 46 percent--took place on the other private owner group's timberland. Almost equal amounts of board foot net growth occurred on forest industry and the other private owner group's timberland.

Net growth per acre was highest on timberlands owned by the other private ownership group (see table 12). Trees on an average acre of timberland in Working Circle 2 grew 30.5 net cubic feet or 102 net board feet Scribner per year.

Mortality The data shows that state and private timberlands in Working Circle 2 lose 10,212,000 net cubic feet of growing stock or 27,788,000 net board feet of sawtimber annually due to natural mortality. This timber is removed from the commercial growing stock by natural causes such as insects, disease, fire, and weather. Timber removed through logging is not considered when computing mortality figures.

On a per acre basis, mortality rates appear to be highest on forest industry-owned lands and lowest on other private timberlands (see table 12). The average annual mortality rate in the working circle was 11.7 cubic feet of growing stock per acre, or 32 board feet Scribner per acre for sawtimber.

Table 10. Net annual growth of growing stock on commercial softwood and hardwood forest types by ownership group, Working Circle 2, (thousand cubic feet).

Ownership Group	Softwood Types -----thousand cubic feet-----	Hardwood Types	Total
State and Other Public	3,634	26	3,660
Forest Industry	12,220	203	12,423
Other Private	<u>10,645</u>	<u>176</u>	<u>10,821</u>
All Owners	26,500	405	26,904



## Area by Site Class

Commercial timberland was placed in one of five productivity classes (see tables 13 and 14). As shown in table 14, more than half of the timberland--57 percent--had the potential to produce from 50 to 84 cubic feet of timber per acre per year. Another 27 percent had the potential to produce more than 84 cubic feet of timber per acre per year. An average sampled acre of commercial timberland in the working circle had the potential to produce 73 cubic feet of timber per year. This is almost equal to the average potential yield for the entire United States--74 cubic feet per acre per year--and higher than the Rocky Mountain region's average of 60 cubic feet per acre per year (USDA Forest Service 1973). (Average potential productivity for the different forest types in Working Circle 2 is shown in table 24, page 46).

Table 14 indicates that the other private ownership group had the highest average potential productivity when compared to the other ownership groups.

Table 11. Net annual growth of sawtimber on commercial softwood and hardwood forest types by ownership group, Working Circle 2, (thousand and board feet Scribner).

Ownership Group	Softwood Types -----thousand board feet -----	Hardwood Types	Total
State and Other Public	12,147	67	12,314
Forest Industry	38,134	779	38,913
Other Private	<u>38,390</u>	<u>616</u>	<u>39,006</u>
All Owners	88,672	1,462	90,134

Table 12. Net annual per acre: mortality, net and gross growth for commercial softwood forest types by ownership group, Working Circle 2, (cubic feet and board feet Scribner).

	Ownership Group			
	State and Other Public	Forest Industry	Other Private	Working Circle Total
Mortality				
Ft <sup>3</sup> /acre	13.2	13.1	8.7	11.7
BFS/acre	27.2	37.5	24.0	31.8
Net Growth				
Ft <sup>3</sup> /acre	29.1	25.7	39.6	30.5
BFS/acre	97.4	80.3	142.9	102.1
Gross Growth				
Ft <sup>3</sup> /acre	42.3	38.8	48.3	42.2
BFS/acre	124.6	117.8	166.9	133.9

Table 13. Area of commercial timberland by forest type and M.A.I. site class, Working Circle 2, (acres).

Forest Type	Site Class (cubic feet/acre/year)					All Classes
	20-49	50-84	85-119	120-164	165+	
	-----acres-----					
Douglas fir	66,737	271,435	50,201	11,556	-	399,928
Ponderosa pine	37,277	83,922	53,404	13,173	-	187,775
Lodgepole pine	21,852	61,164	33,852	2,721	-	119,588
Western larch	10,963	43,421	11,742	-	-	66,126
Subalpine fir-spruce	6,845	26,361	13,638	8,212	-	55,056
Spruce	-	2,738	19,487	5,825	-	28,050
Western redcedar	-	2,738	2,900	-	-	5,638
Whitebark pine	-	2,913	-	-	-	2,913
Grand fir	-	2,500	-	-	-	2,500
Juniper	-	733	-	-	-	733
All softwood types	<u>143,674</u>	<u>497,925</u>	<u>185,224</u>	<u>41,487</u>	<u>-</u>	<u>868,307</u>
Cottonwood	4,675	3,232	5,953	-	-	13,860
Aspen	-	-	1,344	-	-	1,344
All hardwood types	<u>4,675</u>	<u>3,232</u>	<u>7,297</u>	<u>-</u>	<u>-</u>	<u>15,204</u>
All forest types	<u>148,349</u>	<u>501,155</u>	<u>192,520</u>	<u>41,487</u>	<u>-</u>	<u>883,510</u>

Table 14. Area of commercial timberland by M.A.I. site class and ownership group, Working Circle 2, (thousand acres).

Site Class (ft <sup>3</sup> acre/year)	Ownership Group						Working Circle Total	
	State and Other Public		Forest Industry		Other Private			
	-----thousand acres-----		-----thousand acres-----		-----thousand acres-----		-----thousand acres-----	
	%		%		%		%	
20- 49	20.3	16.1	85.3	17.8	42.7	15.3	148.3	16.8
50- 84	66.3	52.5	284.3	59.5	150.6	54.0	501.2	56.7
85-119	33.2	26.3	92.5	19.3	66.7	23.9	192.5	21.8
120-164	6.5	5.1	16.1	3.4	18.9	6.8	41.5	4.7
165+	-	-	-	-	-	-	-	-
Total	<u>126.3</u>	<u>100.0</u>	<u>478.3</u>	<u>100.0</u>	<u>279.0</u>	<u>100.0</u>	<u>883.5</u>	<u>100.0</u>

## The Grazable Forest Land Resource

Of the commercial timberland sampled, 708,600 acres were found to be grazable. An estimated 83 percent of this land was classified as being in good or excellent condition. The carrying capacity on the grazable forest land was judged to be 86,611 AUM's. If every acre of grazable forest land had been in excellent condition, the potential available carrying capacity would be 119,929 AUM's. Actual available carrying capacity was 72 percent of potential.

Range condition, an estimate of the departure from climax based on the species composition of the understory vegetation, was calculated for each field location sampled. It was assumed that the forage potential of understory vegetation in stands of timber with a crown density greater than 70 percent was so low that these sites were not sampled. Also, although unproductive forest lands have the potential to produce relatively large amounts of forage, these lands contained few inventory plots and were not sampled for range condition.

The data summarized in tables 15 through 17 was obtained from grazing guides developed by the SCS. Appendix 7 contains a sample grazing guide and an example of the field data forms used.

### Overall Condition

Understory vegetation was estimated to be in good or excellent condition on 590,800 acres of commercial timberland or 83 percent of the sampled grazable timberland. Understory vegetation on another 117,600 acres was found to be in fair or poor condition. The remaining 175,000 acres had crown densities greater than 70 percent (see table 15).

Commercial timberlands with crown densities of 0-30 percent were the most overgrazed. About 23 percent of these areas were in fair or poor condition. Fifteen percent of the lands within the 31-50 percent crown density group and 13 percent of the lands within the 51-70 percent group had understory vegetation in poor or fair condition.

A comparison of understory conditions shows the other private ownership group had the highest percentage of fair and poor rated forested rangeland in Working Circle 2. About 33 percent of the grazable timberland owned by the other private ownership group was in fair or poor condition compared to 14 percent of the forest industry and 15 percent of the state and other public

land. There were 104,300 acres of privately owned forested range land in fair or poor condition which, unless the condition of the land is currently improving, need re-evaluation of their stocking rates. State and other public timberland had an additional 13,300 acres in fair or poor condition that may also need range management changes. Grazable timberland that was rated as good or excellent could also be experiencing overgrazing.

Forest understories that are experiencing overgrazing should be rested by reducing or eliminating grazing for a period of time. This will allow the natural balance within the plant community to be restored and ultimately increase the forage suitable for grazing. If the understory is not rested and the overgrazing continues, the range condition will keep declining until the forage is virtually worthless for grazing. Overgrazing can also impair the health of livestock, reduce water quality, and adversely affect other resources.

Table 15. Area of commercial timberland by condition class, crown density, and ownership group, Working Circle 2, (thousand acres).

Condition class and crown density	Ownership Group			Total
	State and Other Public	Forest Industry	Other Private	
Excellent	-----thousand acres-----			
0-30	4.7	35.8	8.7	49.1
31-50	12.0	41.6	25.8	79.4
51-70	24.8	71.3	49.8	145.8
Total	<u>41.5</u>	<u>148.7</u>	<u>84.2</u>	<u>274.3</u>
Good				
0-30	12.6	64.6	36.1	113.3
31-50	13.1	59.3	33.0	105.4
51-70	21.1	54.7	22.0	97.8
Total	<u>46.8</u>	<u>178.6</u>	<u>91.2</u>	<u>316.5</u>
Fair				
0-30	5.4	18.0	17.2	40.6
31-50	2.6	11.9	17.4	31.9
51-70	2.1	12.7	15.6	30.4
Total	<u>10.0</u>	<u>42.6</u>	<u>50.2</u>	<u>102.8</u>
Poor				
0-30	2.3	3.1	3.2	8.6
31-50	-	-	-	-
51-70	1.0	0.8	4.5	6.2
Total	<u>3.3</u>	<u>3.8</u>	<u>7.7</u>	<u>14.8</u>
Crown Density Totals				
0-30	24.9	121.4	65.2	211.6
31-50	27.7	112.8	76.2	216.7
51-70	48.9	139.5	91.8	280.3
71+	24.7	104.6	45.7	175.0
Working Circle Totals	<u>126.3</u>	<u>478.3</u>	<u>279.0</u>	<u>883.5</u>



## Current Carrying Capacity

The current carrying capacity, expressed as available animal unit months or AUM's, is drawn from the condition of the forest's understory vegetation, crown density, and an adjustment based on the amount of the area that will be grazed by livestock (primarily cattle). This adjustment is called a grazability factor or utilization cut.

The available AUM's shown in table 16 are actually recommended livestock stocking rates (see the definition of animal units in the glossary). According to the Montana grazing guides, if these stocking rates are followed, understory conditions will gradually improve. Of course, sound range management, including grazing during the correct season of the year and proper distribution of livestock over the grazable forested area, must also be applied.

The total carrying capacity or recommended stocking rate for sampled commercial timberland in Working Circle 2 was estimated to be 86,611 AUM's. The majority of these AUM's--70 percent--were available on Douglas-fir climax sites (see table 118, Appendix 3). Most of this carrying capacity occurred on timberlands with 0-30 percent crown canopies, where shading from tall brush and trees does not inhibit the growth of grazable forage.

Forest industry-owned lands could support 42,670 AUM's, or 49 percent of the working circle total (see table 16).

Table 16. Available animal unit months (AUM's) on commercial timberlands by condition class, crown density, and ownership group, Working Circle 2.

Condition Class and Crown Density	Ownership Group			Total
	State and Other Public	Forest Industry	Other Private	
	-----AUM's-----			
Excellent				
0-30	1,424	8,892	1,697	12,012
31-50	2,749	5,395	4,137	12,281
51-70	<u>2,646</u>	<u>5,626</u>	<u>5,381</u>	<u>13,653</u>
Total	6,819	19,913	5,381	37,946
Good				
0-30	2,005	9,224	6,500	17,729
31-50	1,619	5,537	4,517	11,673
51-70	<u>1,527</u>	<u>3,449</u>	<u>1,419</u>	<u>6,394</u>
Total	5,150	18,210	12,436	35,796
Fair				
0-30	826	2,438	2,451	5,714
31-50	210	1,210	2,085	3,506
51-70	<u>91</u>	<u>426</u>	<u>1,315</u>	<u>1,832</u>
Total	1,127	4,074	5,851	11,052
Poor				
0-30	354	444	393	1,192
31-50	-	-	-	-
51-70	<u>60</u>	<u>29</u>	<u>536</u>	<u>626</u>
Total	415	473	929	1,817
Crown Density Totals*				
0-30	4,609	20,998	11,040	36,647
31-50	4,578	12,141	10,740	27,459
51-70	<u>4,324</u>	<u>9,530</u>	<u>8,651</u>	<u>22,505</u>
Working Circle Totals	13,511	42,670	30,431	86,611

Table 17. Potential animal unit months (AUM's) on commercial timberland by crown density and ownership group, Working Circle 2.

Crown Density	Ownership Group			Total
	State and Other Public	Forest Industry	Other Private	
	-----AUM's-----			
0-30	6,536	29,947	17,176	53,659
31-50	5,848	17,800	16,233	39,881
51-70	4,896	11,244	10,250	26,389
71+	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>
Total	17,280	58,991	43,659	119,929

\*No range data was collected on forest land with greater than 70% crown density because the range is considered to have no value for livestock.

## Potential Carrying Capacity

Timberlands in Working Circle 2 carried 86,611 AUM's or 72 percent of their potential. As shown in table 17, potential available AUM's are the amount that could be supported if every acre of grazable commercial timberland were in excellent condition. In 1978, a total of 119,929 AUM's could have been supported on sampled timberlands in Working Circle 2. Forest industry-owned land had the potential to support the highest number of AUM's--with 58,991 or 49 percent of the potential working circle total. Douglas-fir climax sites could have supported 68 percent of these potential AUM's. Timberlands with 0-30 percent crown canopies could have supported 45 percent.

If every grazable forest acre were in excellent condition, the 1978 carrying capacity could have been increased by 33,318 AUM's. Translated into head of cattle, assuming a four month grazing season, the recommended stocking rate could have been increased from 21,653 to 29,982 head.

The potential number of AUM's depends on more than just the understory condition. Other factors, like the number of acres in each crown density group and the grazability factor also affect the carrying capacity. Obviously, one way to increase AUM's would be to harvest enough timber so that every acre has a crown density of 0-30 percent. A more practical and realistic way to increase potential available AUM's is to increase the grazability through effective range management. Salting, herding, fencing, increasing the number of trails, increasing water developments, and reducing slash, debris, and other mechanical barriers are some of the management techniques that might be used. Properly applied, these methods will increase the amount of grazed forest land and thus the range's carrying capacity.





## ANALYSIS OF THE TIMBER RESOURCE

In this analysis the forest inventory data is examined from a maximizing timber production point of view. The analysis reviews the biological condition of the commercial timberland, assesses timber availability, and assesses the quality of the forest land for timber production. Some specific areas examined were: silvicultural treatment opportunities, stand age distribution, timberland quality classes, current growth and mortality, stocking, and the forest's biological potential for growing wood.

### Forest Condition

An average acre of commercial timberland in the working circle was estimated to have the potential to produce 73 cubic feet of wood per acre per year. The average net growth per acre for softwood forest types was estimated to be 31 cubic feet per year, or about 42 percent of potential net growth. Gross growth in Working Circle 2 when expressed as a percentage of volume was estimated to be higher than what occurs in the Rocky Mountain region on the average. The mortality rate was moderately high and was found to be equal to 27 percent of the total cubic foot gross growth at the time of measurement. The major known causes of tree mortality were weather and insects. State and private timberlands were dominated by low to medium volume sawtimber stands that had less than 10,000 board feet per acre. About two-thirds of the area was covered by stands ranging from 41 to 120 years old. Much of the state and private timberland was not stocked properly for optimum board foot production. One analysis estimated one-third of the timberland acreage in the working circle was improperly stocked for realizing full board foot growth potential. An analysis of basal area by diameter class indicated the commercial timberland was understocked on the average. The same analysis suggested the basal area stocking specifically needed increasing in trees of the ten inch diameter class and larger, assuming a continuous even flow of timber was desirable or possible.

### Growth and Mortality

Gross Growth At the time of measurement, gross growth in cubic feet per year for all growing stock softwood species was about 2.7 percent of the working circle's total cubic foot growing stock softwood volume (see table 18). Lodgepole pine exhibited the highest rate of growth with an annual increase in total cubic foot volume of 3.5 percent. Western larch grew the slowest with a rate of 2.0 percent of its total cubic foot volume.

Table 18. Net volume, gross growth, mortality, and net growth of growing stock and sawtimber by softwood species on commercial timberland, Working Circle 2, (thousand cubic feet, thousand board feet Scribner).

	Growing Stock		Sawtimber	
	M Net Cubic Foot Volume	% of Total Cubic Foot Volume	M Net Board Foot Volume	% of Total Board Foot Volume
Douglas-fir				
Total Volume	457,412	100.0	1,399,848	100.0
Gross Growth	11,052	2.4	39,351	2.8
Mortality	3,363	0.7	9,196	0.7
Net Growth	7,689	1.7	30,155	2.2
Ponderosa Pine				
Total Volume	277,483	100.0	1,058,730	100.0
Gross Growth	7,010	2.5	31,564	3.0
Mortality	1,118	0.4	3,901	0.4
Net Growth	5,892	2.1	27,662	2.6
Lodgepole Pine				
Total Volume	297,544	100.0	469,342	100.0
Gross Growth	10,389	3.5	21,194	4.5
Mortality	2,472	0.8	4,261	0.9
Net Growth	7,917	2.7	16,933	3.6
Western Larch				
Total Volume	152,856	100.0	611,299	100.0
Gross Growth	3,093	2.0	9,189	1.5
Mortality	668	0.4	2,525	0.4
Net Growth	2,425	1.6	6,663	1.0
All Other Softwoods				
Total Volume	190,558	100.0	644,165	100.0
Gross Growth	4,969	2.6	13,809	2.1
Mortality	2,315	1.2	6,712	1.0
Net Growth	2,655	1.4	7,097	1.1
Total For All Softwoods				
Total Volume	1,375,853	100.0	4,183,385	100.0
Gross Growth	36,514	2.7	115,106	2.8
Mortality	9,935	0.7	26,595	0.6
Net Growth	26,579	1.9	88,511	2.1

Gross growth in board feet Scribner for all softwood sawtimber species was about 2.8 percent of the working circle's total board foot volume. Lodgepole pine also showed the highest growth rate in this category with 3.5 percent of its total board foot volume. Western larch again grew the least with 2.0 percent. In comparison, gross growth of softwood species in the entire Rocky Mountain region was 2.2 percent of both the total cubic foot and board foot softwood volumes (USDA Forest Service 1978).

Most of the growth in the working circle occurred in Douglas-fir. Table 18 shows that 30 percent of the cubic foot growth in all softwood species, as well as 34 percent of the board foot growth in these species, occurred in Douglas-fir.

Gross growth by diameter class data indicates smaller diameter trees grow more quickly than older trees and the growth rate decreases with age (see tables 19 and 20). This data also shows that over half of the forest's gross growth, both in cubic feet and board feet, occurred in the two smallest diameter classes. The large amount of growth shown in the smallest diameter class is primarily caused by ingrowth.

Mortality The data collected in 1978 indicates that mortality was occurring at a moderately high rate. Mortality in softwoods, expressed as a percentage of the total softwood volume, was 0.7 percent of the total cubic foot volume or 0.6 percent of the total board foot volume on commercial timberlands in Working Circle 2. Mortality in the entire Rocky Mountain region was estimated at 0.5 percent of the total cubic foot and total board foot volumes (USDA Forest Service 1978). In 1978, mortality equalled 27 percent of the cubic foot gross growth and 23 percent of the board foot gross growth taking place in the working circle.

As shown in table 18, the mortality rate was lowest in ponderosa pine and western larch with each species exhibiting a rate of 0.4 percent in both cubic feet and board feet.

Tables 19 and 20 show mortality rates generally decline as diameter class increases until the 22-inch diameter class is reached. At that point the trend reverses and mortality rates increase as the diameter class increases. Eventually mortality rates become high enough and growth slow enough that the trees are dying faster than they are growing. In Working Circle 2, softwood trees 27 inches in diameter or larger have reached that situation.

Table 19. Net volume, gross growth, mortality, and net growth of growing stock on commercial timberland by diameter class for softwood species, Working Circle 2, (thousand cubic feet).

Diameter Class	Volume	Gross Growth		Mortality		Net Growth	
		-----thousand cubic feet-----		-----thousand cubic feet-----		-----thousand cubic feet-----	
			%*		%*		%*
5.0 - 6.9	178,250	13,937	7.8	1,901	1.1	12,036	6.8
7.0 - 8.9	225,498	5,542	2.5	1,868	0.8	3,674	1.6
9.0 - 10.9	204,645	4,819	2.4	1,467	0.7	3,352	1.6
11.0 - 12.9	171,266	3,598	2.1	1,237	0.7	2,361	1.4
13.0 - 14.9	141,378	2,806	2.0	770	0.5	2,036	1.4
15.0 - 16.9	119,766	2,015	1.7	407	0.3	1,608	1.3
17.0 - 18.9	87,083	1,286	1.5	297	0.3	989	1.1
19.0 - 20.9	65,078	881	1.4	150	0.2	731	1.1
21.0 - 22.9	53,157	525	1.0	280	0.5	245	0.5
23.0 - 24.9	35,640	381	1.1	323	0.9	58	0.2
25.0 - 26.9	27,065	257	0.9	195	0.7	62	0.2
27.0 - 28.9	15,207	109	0.7	221	1.5	-112	-0.7
29.0+	51,821	356	0.7	817	1.6	-461	-0.9
Total	1,375,853	36,514	2.7	9,935	0.7	26,579	1.9

Table 20. Net volume, gross growth, mortality, and net growth of sawtimber on commercial timberland by diameter class for softwood species, Working Circle 2, (thousand board feet Scribner).

Diameter Class	Volume	Gross Growth		Mortality		Net Growth	
		-----thousand board feet-----		-----thousand board feet-----		-----thousand board feet-----	
			%*		%*		%*
9.0-10.9	599,787	48,271	8.0	4,272	0.7	43,999	7.3
11.0-12.9	691,424	19,788	2.9	5,198	0.8	14,591	2.1
13.0-14.9	623,425	15,345	2.5	3,384	0.5	11,961	1.9
15.0-16.9	559,140	10,833	1.9	1,881	0.3	8,952	1.6
17.0-18.9	421,551	6,901	1.6	1,389	0.3	5,512	1.3
19.0-20.9	321,898	4,725	1.5	690	0.2	4,035	1.3
21.0-22.9	271,510	2,956	1.1	1,414	0.5	1,542	0.6
23.0-24.9	185,086	2,125	1.1	1,705	0.9	420	0.2
25.0-26.9	141,333	1,455	1.0	1,037	0.7	418	0.3
27.0-28.9	81,678	631	0.8	1,174	1.4	-544	-0.7
29+	286,552	2,077	0.7	4,452	1.6	-375	-0.8
Total	4,183,385	115,106	2.8	26,595	0.6	88,511	2.1

\*Percent of total volume in each diameter class.



The major causes of tree death in 1978 were categorized as weather, unknown, and insects (see tables 21 and 22). Weather caused tree mortality by windthrow, snow breakage, and lightning. The category termed "unknown" was used by inventory crews when they could not determine which damaging agent was primarily responsible for killing the tree. The inventory's mortality tree procedure allowed only one damaging agent to be recorded, frequently the death of a tree was caused by two or more agents in concert or succession. Mortality caused by insects was generally due to bark beetles and occasionally defoliators.

Douglas-fir and spruce were the major victims of weather, while most of the trees killed by "unknown" factors were lodgepole pine and Douglas-fir. Because the inventory crews had limited experience at identifying root diseases, it has been suggested that much of the Douglas-fir mortality recorded as caused by weather was probably primarily caused by root rots. Mortality due to insects was highest in ponderosa pine and lodgepole pine.

Disease, logging, and fire also contributed significantly to mortality. Disease includes various rots, rusts, and mistletoe. Logging mortality includes trees killed during the logging operation -- it does not include the actual trees cut for harvest.

At the time of measurement, weather and insects shared dominant roles as the major causes of death in Working Circle 2. However, the causes of mortality in a forest are dynamic and cyclic, and in a future inventory the major causes of death may be different. The mountain pine beetle (Dendroctonus ponderosae Hopk.) epidemic had just begun in 1978 and has continued in various locations since that time. Lodgepole and ponderosa pine are the species that will be affected most by this epidemic.

Table 21. Net annual mortality of growing stock on commercial timberland by species and cause of death, Working Circle 2, (thousand cubic feet).

Species	Cause of Death						Total All Causes		
	Insects	Disease	Fire	Animal	Weather thousand cubic feet	Suppression			
Douglas fir	541	275	474	-	1,218	37	590	229	3,363
Ponderosa pine	676	-	57	-	39	7	308	30	1,118
Lodgepole pine	438	350	-	-	352	-	1,281	51	2,472
Western larch	95	-	-	-	234	-	339	-	668
Subalpine fir	89	211	-	-	98	-	575	-	973
Spruce	41	-	-	-	618	-	281	117	1,058
Western redcedar	-	-	-	-	-	-	103	-	103
Whitebark pine	-	-	-	-	-	-	73	-	73
Grand fir	35	-	-	-	-	-	-	-	35
Juniper	-	-	-	-	-	-	-	-	-
Western white pine	-	73	-	-	-	-	-	-	73
Total softwoods	1,915	908	531	-	2,559	45	3,550	428	9,935
Cottonwood	-	-	32	-	-	-	-	-	32
Aspen	-	66	-	-	63	-	116	-	245
Total hardwoods	-	66	32	-	63	-	116	-	277
Total all species	1,915	974	562	-	2,622	45	3,666	428	10,212

Table 22. Net annual mortality of sawtimber on commercial timberland by species and cause of death, Working Circle 2 (thousand board feet Scribner).

Species	Cause of Death							Total All Causes
	Insects	Disease	Fire	Animal	Weather thousand board feet	Suppression	Unknown	
Douglas fir	983	686	450	-	5,272	-	1,259	9,196
Ponderosa pine	2,682	-	113	-	162	-	944	3,901
Lodgepole pine	1,121	927	-	-	808	-	1,405	4,261
Western larch	360	-	-	-	1,064	-	1,101	2,525
Subalpine fir	-	715	-	-	-	-	1,224	1,940
Spruce	-	-	-	-	2,637	-	1,086	4,021
Western redcedar	-	-	-	-	-	-	396	396
Whitebark pine	-	-	-	-	-	-	-	-
Grand fir	-	-	-	-	-	-	-	-
Juniper	-	-	-	-	-	-	-	-
Western white pine	-	355	-	-	-	-	-	355
Total softwoods	5,147	2,683	562	-	9,944	-	7,416	26,595
Cottonwood	-	-	133	-	-	-	-	133
Aspen	-	286	-	-	270	-	504	1,060
Total hardwoods	-	286	133	-	270	-	504	1,193
Total all species	5,147	2,970	696	-	10,214	-	7,920	27,788

Net Growth In 1978, net growth of softwoods in Working Circle 2 was 26,579,000 cubic feet for growing stock and 88,511,000 board feet for sawtimber. This represented 1.9 percent of the softwood cubic foot volumes and 2.1 percent of the softwood board foot volume (see tables 19 and 20). For the Rocky Mountain region as a whole, net growth of softwoods was 1.7 percent (USDA Forest Service 1978). Lodgepole pine showed the highest net growth rate, increasing its cubic foot volume by 2.7 percent and its board foot volume by 3.6 percent.

Over time, net growth will increase or decrease in response to changes in mortality rates, harvest rates, amounts of insects or disease, and the forest's stocking and age distribution. All of these factors can be manipulated to some degree through the management practices applied to the forest.



## Potential Growth

Potential growth or yield is net growth expressed in cubic feet per acre per year as calculated by the forest inventory computation process. The estimate is based on yield tables developed for fully stocked, even-aged stands of single species. These yield tables are used to construct mean annual increment curves. Site indices derived from site trees measured on the field location are used to choose the proper mean annual increment curve. The potential cubic foot yield per acre per year is determined based on the culmination point of the mean annual increment curve. The age at the culmination point is the biological harvest age for producing the maximum amount of wood. This estimate of biological potential is considered to be less than the potential for intensively managed stands.

The average potential net growth for all forest types in Working Circle 2 was estimated to be 73 cubic feet per acre per year (see table 23). Average gross growth per acre for softwood forest types in Working Circle 2 was estimated to be 42 cubic feet per year, or about 58 percent of potential net growth. The average net growth per acre for softwood forest types was estimated to be 31 cubic feet per year, or about 42 percent of potential net growth. Nationally, net growth was 38 cubic feet per acre per year or about 51 percent of potential net growth in 1970. Net growth for the Rocky Mountain region was estimated to be 24 cubic feet per acre per year or about 40 percent of potential net growth (USDA Forest Service 1973).

When a forest is composed of stands in many age classes, a gap between net growth and potential net growth should be expected. However, a large gap between net growth and potential net growth may indicate management opportunities exist to increase production. Studying the forest's growth-related physical characteristics should suggest ways to reduce this gap.

Table 23. Average potential productivity per acre by forest type for commercial timberland, Working Circle 2.

Forest Type	Average Potential Productivity (in cubic feet/acre)	Net growth (cubic feet/acre)
Douglas fir	68.6	24.8
Ponderosa pine	76.3	26.5
Lodgepole pine	71.8	69.2*
Western larch	70.1	19.8
Subalpine fir-spruce	82.1	13.3
Spruce	105.6	40.6
Other softwood types	<u>70.6</u>	<u>11.1</u>
All softwood types	73.0	30.5
Cottonwood	72.3	28.3
Aspen	<u>91.1</u>	<u>9.4</u>
All hardwood types	74.0	26.6
All forest types	<u>73.0</u>	<u>30.5</u>

Table 24. Area of commercial timberland by stand size class and insect and disease category, Working Circle 2, (thousand acres).

Stand Size Class	Insect and Disease Category					Total
	Bark					
	Unclassified	Beetles	Defoliators	Mistletoe	Rot	
	-----thousand acres-----					
Old growth sawtimber	101.0	44.0	18.9	34.7	19.4	218.0
Young growth sawtimber	172.2	34.3	45.8	36.3	9.9	298.5
Poletimber	83.1	28.0	26.4	10.4	6.4	154.4
Seedlings and saplings	145.5	16.3	12.1	14.0	2.7	190.6
Nonstocked	<u>20.8</u>	<u>1.3</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>22.1</u>
Total	522.6	123.9	103.2	95.4	38.4	883.5

\*This particular statistic reflects the effects of a large amount of ingrowth.

## Insects and Disease

Insects and disease were attacking trees on 360,900 acres or 41 percent of the commercial timberland in 1978. Both the growth (vigor) of a forest and the mortality rate are affected by the amount of insect and disease activity. Bark beetles were found on more acres than any other insect or disease problem. Defoliators were the most common pest in young growth sawtimber stands, but bark beetles were the most common problem in all other stand size classes (see table 24).

Bark beetles are a very serious problem. They usually kill a tree when they attack in large numbers, as they were doing in 1978 and are still doing. Bark beetles were evident on 123,900 acres of sampled land in Working Circle 2. Defoliating insects, such as spruce budworm, rarely kill a tree but are detrimental because they reduce the tree's growth rate. Defoliators were a problem on 103,200 acres. Dwarf mistletoe takes its water and nutrients from the host tree, reducing height and diameter growth rates, weakening the tree, and sometimes killing it directly. Mistletoe was slowing the growth of trees on 95,400 acres. Rots were weakening and destroying the wood on 38,400 acres, making some of the trees unusable for products.

## Existing Stand Structure

Distribution by Stand Size Class Sawtimber stands dominated in Working Circle 2 according to distribution by stand size class data. Sawtimber stands occurred on 58 percent of the commercial timberland acreage at the time of sampling. Only 22,100 acres, or 2.5 percent of all timberlands in the working circle, were found to be nonstocked (see figure 7).

Distribution by Stand Age Class Distribution by stand age class data showed much of the timberland acreage to be occupied by medium aged stands. About 66 percent of the total softwood acreage -- 576,800 acres -- was covered by stands 41 to 120 years old. About 30 percent of the softwood stands were found to be over 100 years old (see table 25).

Distribution by age class between ownership groups was fairly uniform. A slightly higher percentage of forest industry lands were in younger stand age classes.

Distribution by Stand Volume Class Most stands of timber in Working Circle 2 fell into the lower stand volume classes. Overall, 56 percent of the commercial timberland had less than 5,000 board feet Scribner per acre. Stands in the higher volume classes, which carried at least 10,000 board feet per acre, occurred on only 123,200 acres or 14 percent of the commercial timberlands in the working circle (see table 26).

Privately owned timberlands -- including forest industry timberlands -- contained very few high volume stands. Only 13 percent of the privately owned commercial timberland contained 10,000 or more board feet per acre. Stands with less than 5,000 board feet per acre occurred on 57 percent of the private acreage.

Distribution by Stocking Percent Stocking is a qualitative term used to describe the "degree of adequacy" of a stand in a particular condition to meet a certain timber management objective (Gingrich 1964). Table 27 shows an assessment of the forest's stocking for producing board-foot volume by displaying the amount of area in each stocking percent class. Stocking percent is the amount of space available to one live tree on a given acre compared to the amount of space necessary for optimum yield, measured as a percentage.

Figure 7. Area of commercial timberland by stand size class, Working Circle 2, (acres).

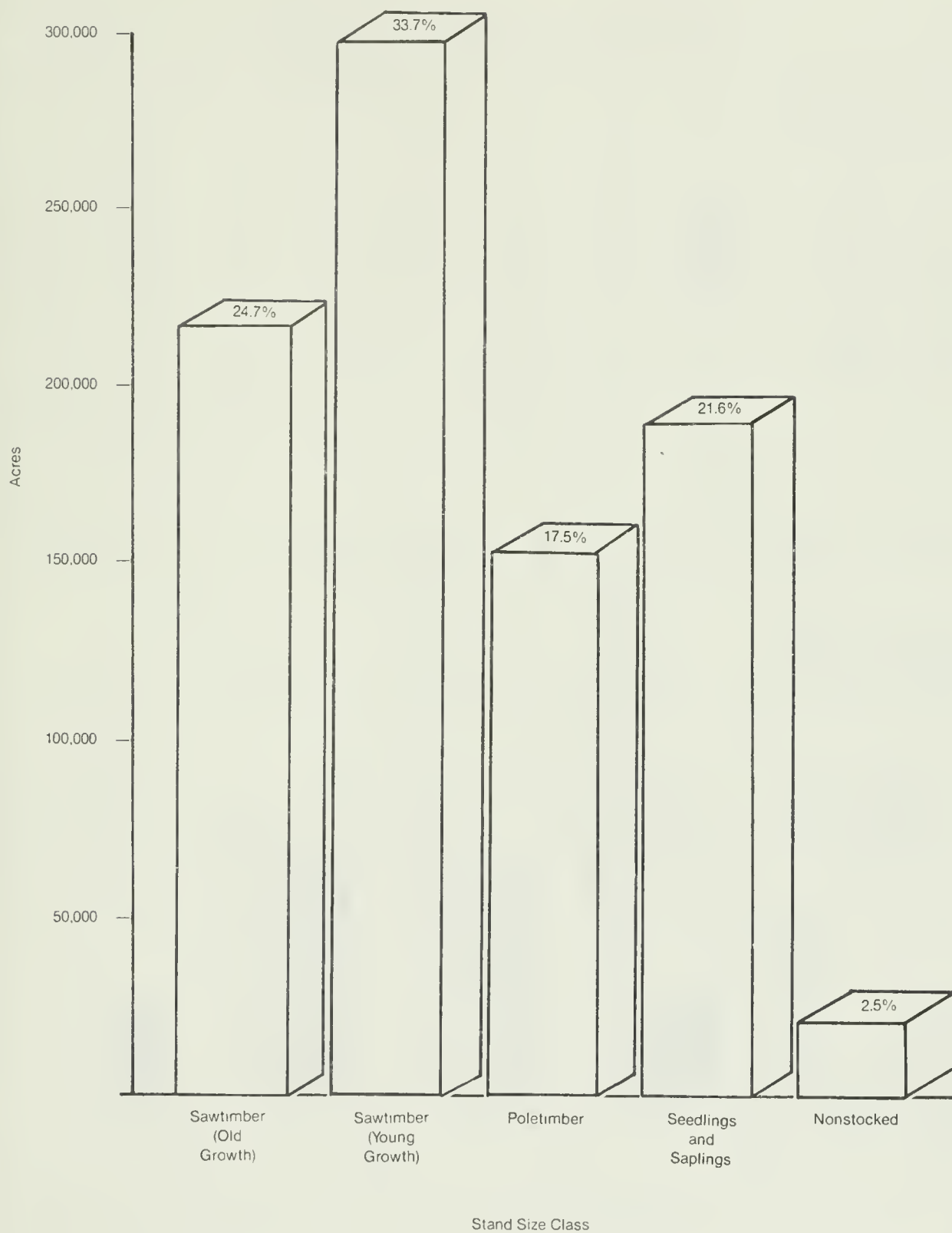




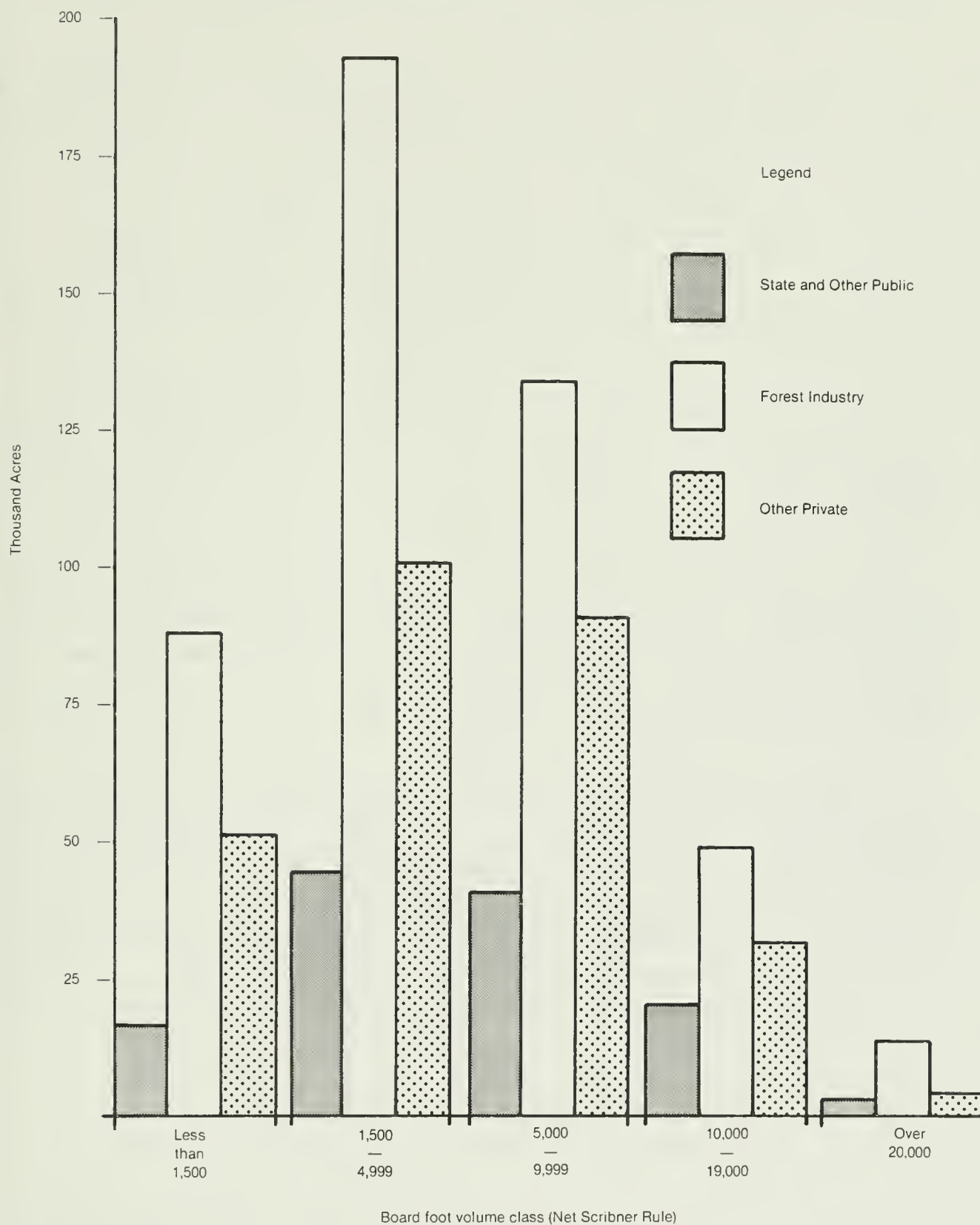
Table 25. Area of commercial softwood timberland by stand age class and ownership group, Working Circle 2, (thousand acres).

Stand Age Class	Ownership Groups							
	State and		Forest		Other		Total	
	Other Public		Industry		Private			
	-----thousand		acres-----					
	%		%		%		%	
Unclassified	2.7	2.2	11.9	2.5	3.7	1.4	18.3	2.1
1 - 20	2.6	2.1	61.9	13.0	13.5	5.0	78.0	9.0
21 - 40	4.4	3.5	14.3	3.0	12.1	4.5	30.8	3.5
41 - 60	10.3	8.3	50.7	10.7	41.6	15.5	102.6	11.8
61 - 80	41.3	33.1	88.5	18.6	99.9	37.2	229.8	26.5
81 - 100	23.5	18.8	83.9	17.7	44.9	16.7	152.3	17.5
101 - 120	17.0	13.6	46.5	9.8	28.7	10.7	92.1	10.6
121 - 140	8.9	7.1	46.3	9.7	10.1	3.7	65.4	7.5
141 - 160	5.7	4.6	31.2	6.6	6.4	2.4	43.2	5.0
161 - 180	5.1	4.1	15.3	3.2	5.3	2.0	25.7	3.0
181 - 200	1.9	1.5	16.4	3.5	2.3	0.9	20.5	2.4
201+	1.4	1.1	8.2	1.7	-	-	9.5	1.1
Total	124.7	100.0	475.0	100.0	268.6	100.0	868.3	100.0

Table 26. Area of commercial timberland by stand volume class and ownership group, Working Circle 2, (thousand acres).

Board Foot/Acre Volume Class (Net Scribner Rule)	Ownership Group							
	State and		Forest		Other		Total	
	Other Public		Industry		Private			
	-----thousand		acres-----					
	%		%		%		%	
Less than 1,500	16.8	13.3	88.3	18.5	51.2	18.4	156.3	17.7
1,500- 4,999	45.0	35.7	192.8	40.3	100.7	36.1	338.4	38.3
5,000- 9,999	40.8	32.3	134.0	28.0	90.7	32.5	265.5	30.1
10,000-19,999	20.6	16.3	49.2	10.3	31.7	11.4	101.6	11.5
Over 20,000	3.0	2.4	14.0	2.9	4.5	1.6	21.6	2.4
Total all classes	126.3	100.0	478.3	100.0	279.0	100.0	883.5	100.0

Figure 8. Area of commercial timberland by stand volume class, Working Circle 2, (thousand acres).



The amount of space needed for optimum yield depends on tree size and site quality. Consequently, the desired amount of space will vary from one sampled acre to the next (Farrenkopf 1967).

There are three stocking percent classes: less than 60 percent stocked (understocked), 60 to 132 percent stocked, and greater than 132 percent stocked (overstocked). Each field plot can be up to 167 percent stocked, since each individual sample point of the ten point cluster can be up to 16.7 percent stocked (10 points x 16.7 percent stocking per point = 167 percent stocking per field plot), depending on the size and number of trees present. Some of the individual sample points tally more trees than required to be 16.7 percent stocked. In those instances the stocking percent remains 16.7 and will go no higher. A stocking percent class rating of 100 percent is equivalent to 60 percent of the basal area listed by a normal yield table. A normal yield table shows the maximum volume, number of trees, and basal area that a given site can support at a given age (Davis 1966). A stocking percent class rating of 132 percent is equivalent to 80 percent of the basal area listed by a normal yield table. Volume predictions made by normal yield tables are for fully stocked stands grown under "natural" conditions without competition and do not predict the yield that could be captured from a given site if managed. It is believed that a range of stocking between 60 and 100 percent of the normal yield table basal area is the range within which the full board-foot growth potential of a forest acre can be realized. Theoretically, trees in this stocking range are beginning to fully use the site and growth per acre is not reduced by overcrowding.

Table 27 shows that at the time of sampling about one-third of the commercial timberland in Working Circle 2 was improperly stocked for realizing its full board foot growth potential. Approximately 212,300 acres were understocked and 88,900 acres were overstocked. Many of the overstocked pole-timber and seedling-sapling stands, jointly covering about 55,800 acres, represent potential thinning opportunities. In the future, some of the medium stocked and understocked stands may also require thinning before they reach merchantability.

Table 27. Area of commercial timberland by ownership group, stand size class, and stocking percent class, Working Circle 2, (thousand acres).

	Stocking Percent Class							
	59 or less		60-132		133 or more		Total	
	(understocked)				(overstocked)			
	-----thousand acres-----							
State and Other Public		%		%		%		%
Old growth sawtimber	11.9	9.4	21.2	16.8	0.5	0.4	33.6	26.6
Young growth sawtimber	11.9	9.4	36.2	28.7	5.6	4.4	53.7	42.5
Poletimber	0.3	0.2	14.4	11.4	5.5	4.4	20.2	16.0
Seedlings and saplings	5.2	4.1	10.3	8.2	0.1	0.1	15.6	12.4
Nonstocked	3.1	2.5	-	-	-	-	3.1	2.5
Totals	32.4	25.6	82.1	65.1	11.7	9.3	126.3	100.0
Forest Industry								
Old growth sawtimber	22.3	4.7	99.3	20.8	13.6	2.8	135.3	28.3
Young growth sawtimber	28.9	6.1	89.4	18.7	5.5	1.1	123.7	25.9
Poletimber	5.5	1.1	49.0	10.2	27.4	5.7	81.9	17.0
Seedlings and saplings	38.8	8.1	78.3	16.4	8.4	1.8	125.4	26.3
Nonstocked	12.0	2.5	-	-	-	-	12.0	2.5
Totals	107.5	22.5	316.0	66.1	54.9	11.4	478.3	100.0
Other Private								
Old growth sawtimber	13.6	4.9	30.2	10.8	5.3	1.9	49.1	17.6
Young growth sawtimber	30.6	11.0	87.7	31.4	2.7	1.0	121.0	43.4
Poletimber	2.7	1.0	36.5	13.1	13.0	4.7	52.3	18.8
Seedlings and saplings	18.5	6.6	29.7	10.6	1.4	0.5	49.6	17.7
Nonstocked	7.0	2.5	-	-	-	-	7.0	2.5
Totals	72.4	26.0	184.1	65.9	22.4	8.1	279.0	100.0
Total For Working Circle								
Old growth sawtimber	47.8	5.4	150.7	17.1	19.4	2.2	218.0	24.7
Young growth sawtimber	71.4	8.1	213.4	24.1	13.7	1.5	298.5	33.7
Poletimber	8.5	1.0	99.9	11.3	45.9	5.2	154.4	17.5
Seedlings and saplings	62.4	7.1	118.3	13.4	9.9	1.1	190.6	21.6
Nonstocked	22.1	2.5	-	-	-	-	22.1	2.5
Total	212.3	24.1	582.3	65.9	88.9	10.0	883.5	100.0

Basal Area by Diameter Class The basal area by diameter class for the average acre of commercial softwood forest land in 1978 is displayed by owner group in figures 10, 11, 12, 13, 14 and 15. On the basis of trees in the 20-84 site class, privately owned land exhibited the lowest basal area per acre, with an average of 69 square feet per acre. State and other publicly owned land exhibited the highest basal area per acre with 76 square feet. A different situation was found in the 85 plus productivity classes. The other private ownership group had the highest average basal area per acre with 106 square feet. State and other publicly owned land had the lowest with an average of 99 square feet per acre.

Figure 9 shows the expected basal area per acre by diameter class curve for an average acre of forest land if the forest land base were brought under full management and were fully regulated. The shape of the desired curve is based on a theoretical situation where the forest is fully regulated and a variety of round-wood materials (pulp, poles, and saw logs) are product objectives (Green 1976). When regulated, the forest would consist of many individual stands of trees with different ages and sizes. All of these different stands, viewed as one, would give the appearance of a forest managed by the selection method. The basal area in trees less than 10 inches d.b.h. should be about 40 percent of the basal area in trees 10 inches d.b.h. and larger, or about 30 percent of the total basal area (Green 1976). The desired amount of basal area stocking under the curve is the average level of stocking which should be carried over the life of the stand. Under intensive management, the stand would be allowed to grow to a higher basal area per acre stocking level than desired. It then would be thinned back to a level below the desired stocking level. This process might be repeated several times until the stand is finally harvested. Under an uneven-aged management

Table 28. Percent of total basal area per acre on softwood commercial timberland below the 10-inch diameter class by ownership group and MAI site class, Working Circle 2.

Owner Group	MAI Site Class (Ft <sup>3</sup> /acre/year)	
	20-84	85+
State and Other Public	32%	31%
Forest Industry	48%	33%
Other Private	46%	34%



scheme, certain trees in a stand would be harvested on a periodic basis but the desired average basal area per acre would still be maintained.

Percent of total basal area per acre below the 10-inch diameter class at the time of sampling is shown in table 28. All state and other public land and all privately owned lands on sites of 85 cubic feet per acre per year or better were close to the recommended stocking level of 30 percent of total basal area below the 10-inch d.b.h. class (see figure 9 for clarification).

At first glance, the percentage of basal area below the 10-inch diameter class would indicate thinning is needed to balance out the diameter distribution on the privately owned lower site land. This would probably be true if the average acre were stocked at or above the desired amount. However, this does not appear to be the case when the average stand age, site class, and forest type composition of the forest represented by each curve are taken into account. All the sites appear to be understocked, especially when compared to basal area standard tables.\* The degree to which these sites are understocked varies according to the management regime, which is chosen based on the objectives of the land owner or manager.

If the average forest acre is understocked, the average amount of basal area per acre may actually be low for all owners on all site classes. Thinning opportunities would still be available, but at a level below the initial estimate. Evidence of understocking would indicate that there are areas where stocking needs to be increased by natural or artificial regeneration if higher yields are desired.

The graphs in figures 10 through 15 represent a one-point-in-time picture of the average basal area per acre by diameter class. The key to developing timber management strategies based on these graphs is to know the direction and rate of change occurring within each diameter class. Estimates concerning the changes or dynamics of the forest can best be made by analyzing remeasurement data. Unfortunately, such data is not available at this time.

\*For example, according to basal area standard tables for western larch (derived from Schmidt, et al. 1976), 80-year-old stands on MAI sites of 60 cubic feet per acre per year should have a basal area stocking of 132 square feet per acre. Eighty-year-old stands on MAI sites of 110 cubic feet per acre per year should have a basal area stocking of 157 square feet per acre.

Figure 9 • Example of the shape of the desired average basal area per acre by diameter class curve, providing a variety of round-wood materials are product objectives. The amount of basal area depicted by the curve is depended on the management regime and the productivity of the land to produce wood.

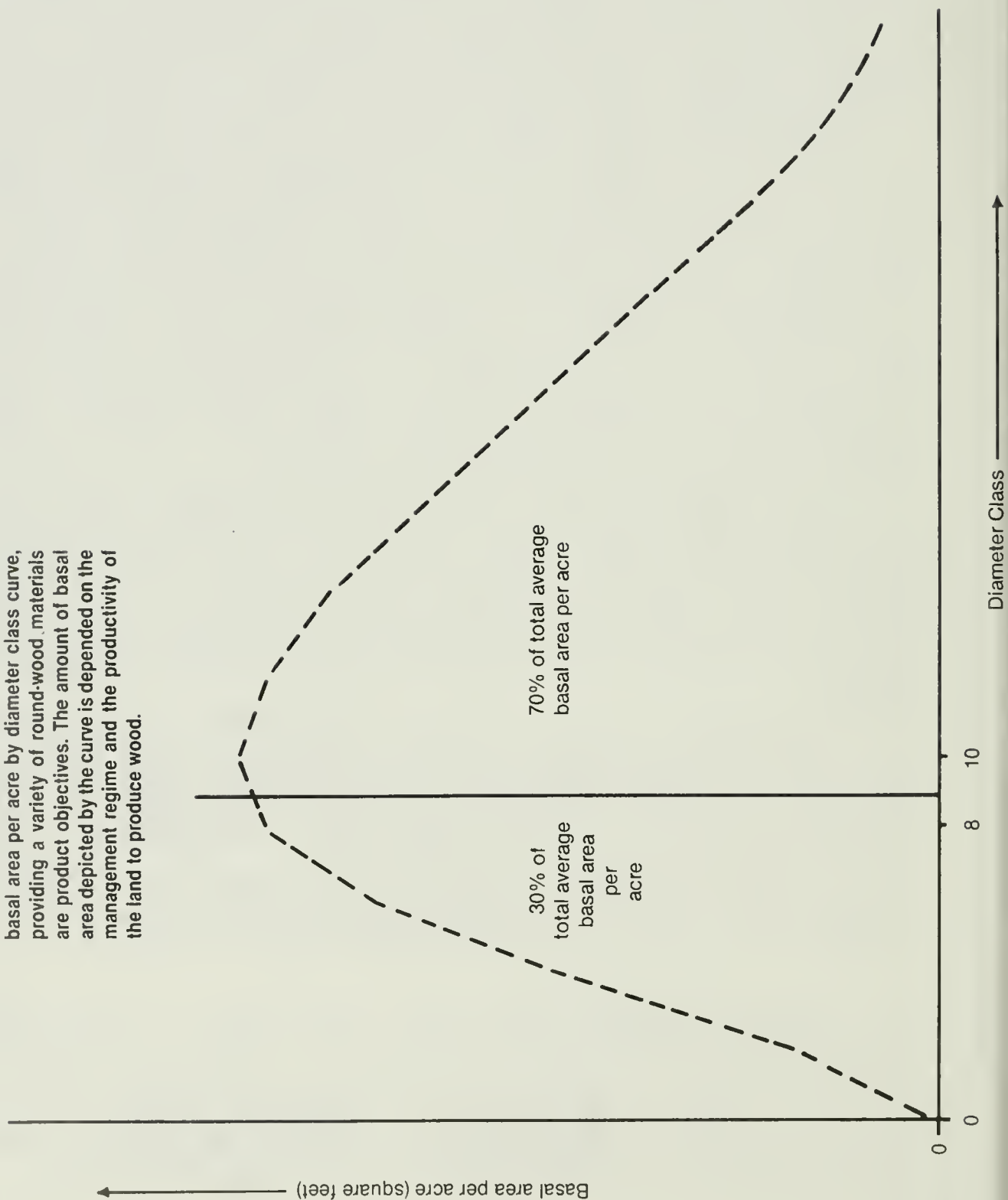


Figure 10 • Current average basal area per acre for softwoods by diameter class, MAI site class 20-84, state and other public, Working Circle 2.

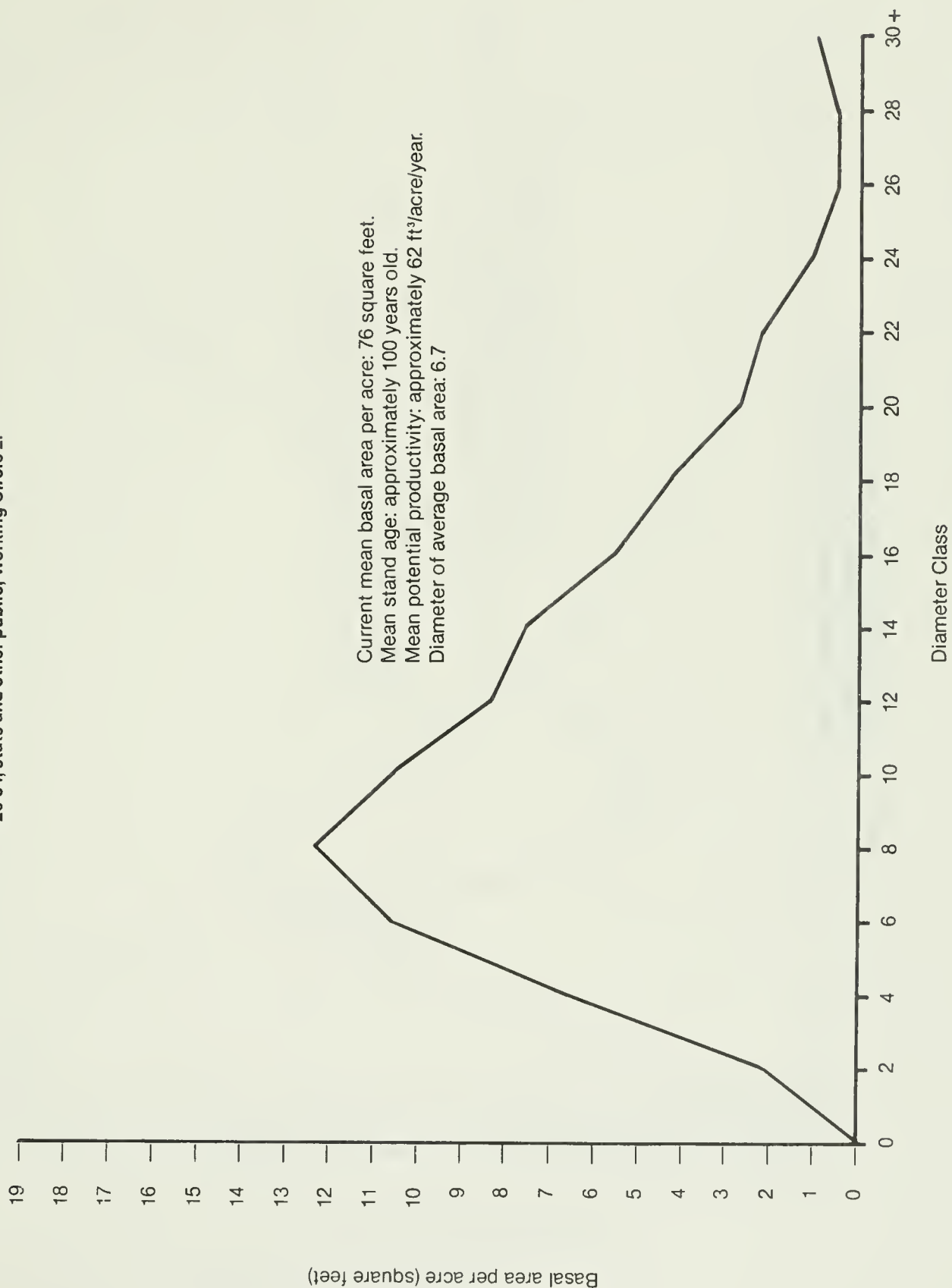


Figure 11 • Current average basal area per acre for softwoods by diameter class, MAI site class 85 +, state and other public, Working Circle 2.

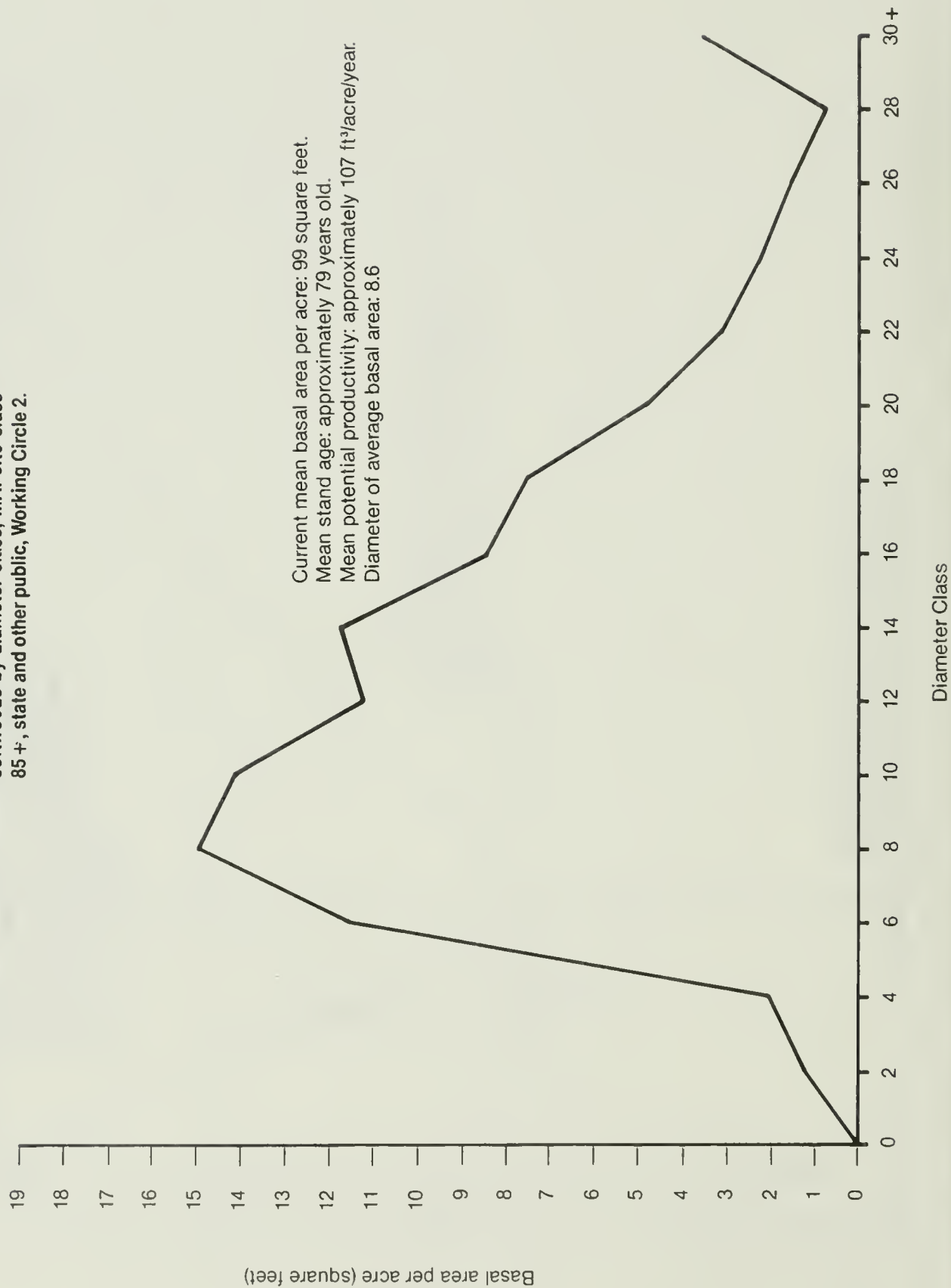
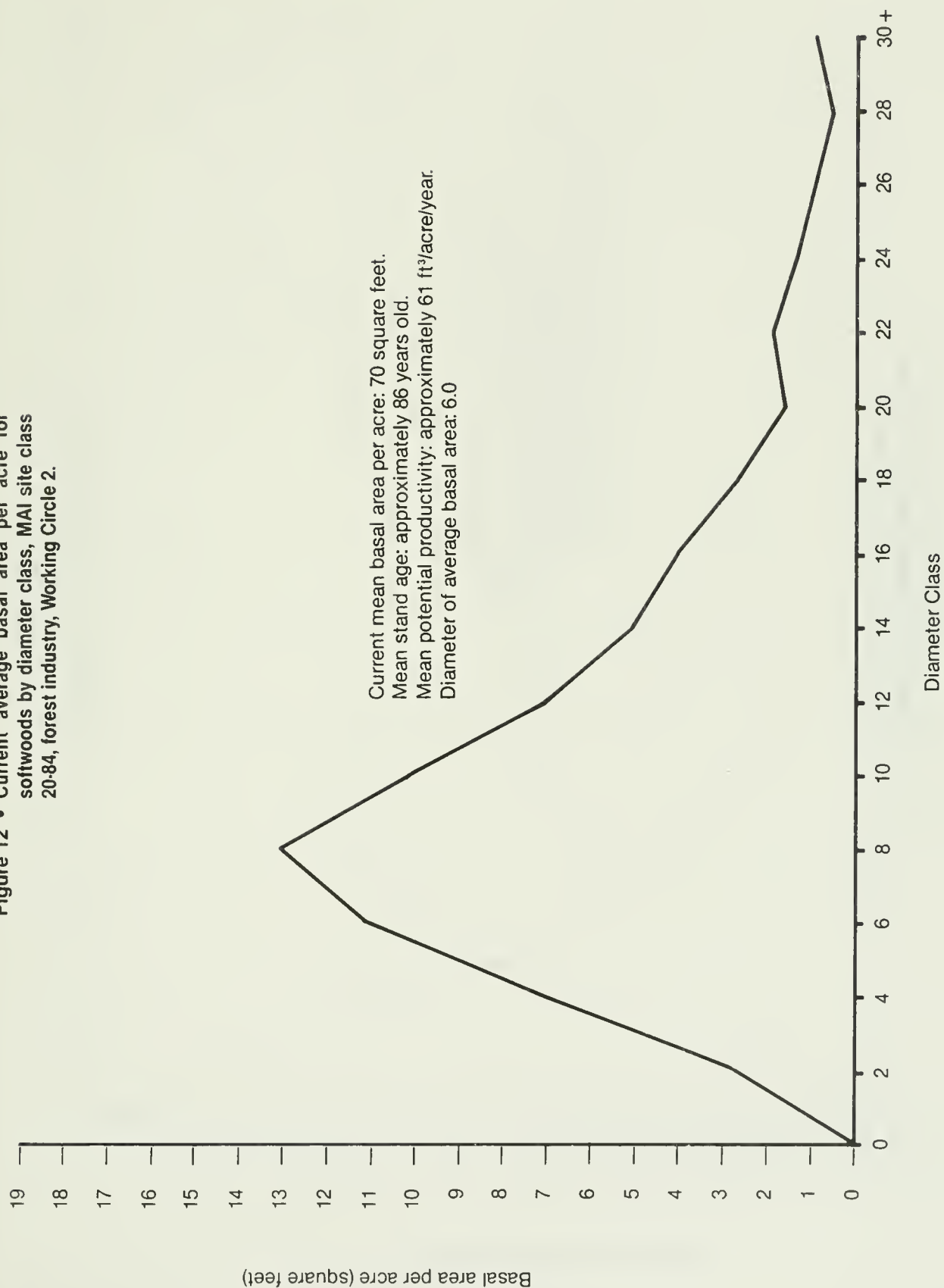
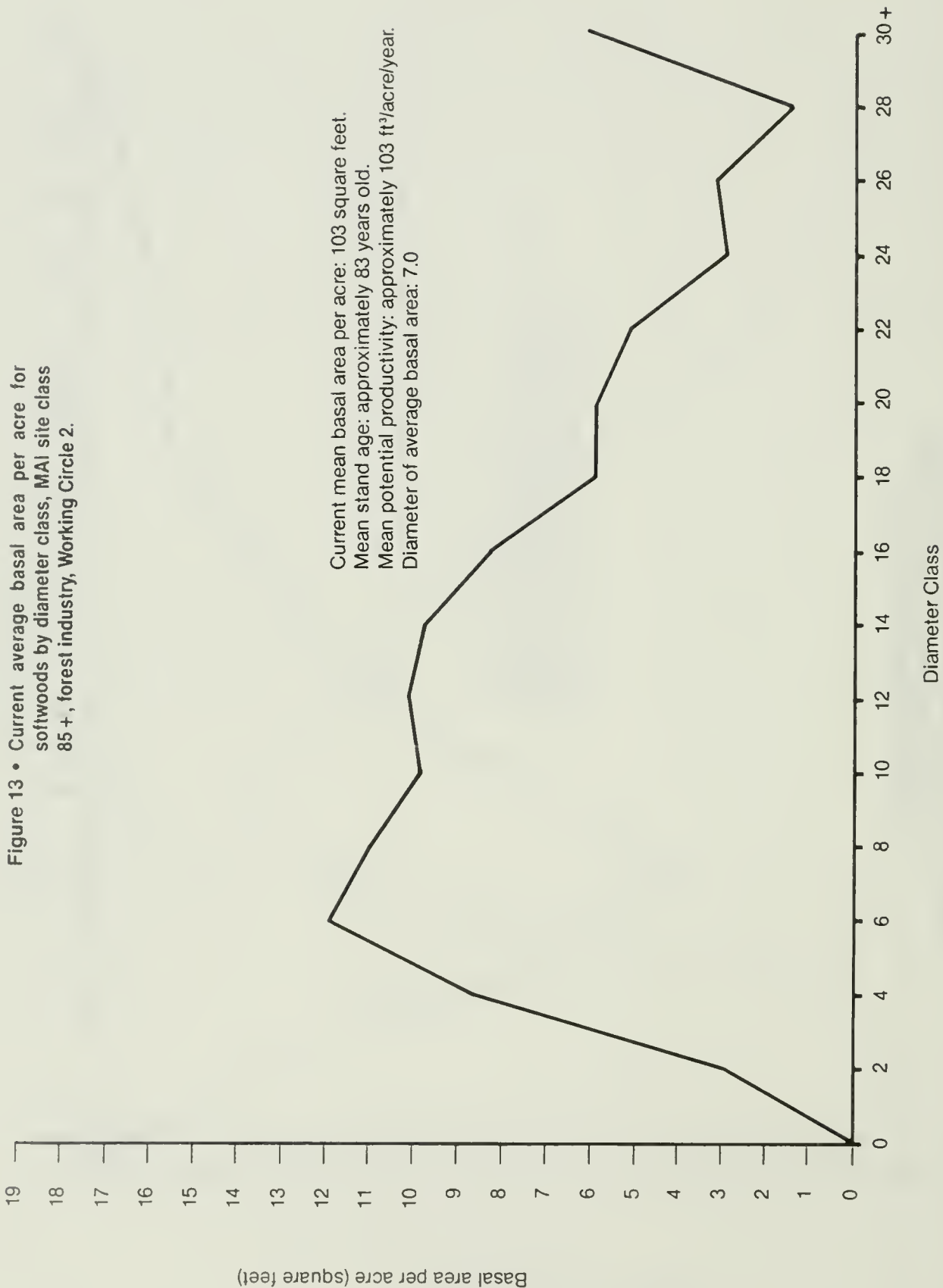


Figure 12 • Current average basal area per acre for softwoods by diameter class, MAI site class 20-84, forest industry, Working Circle 2.







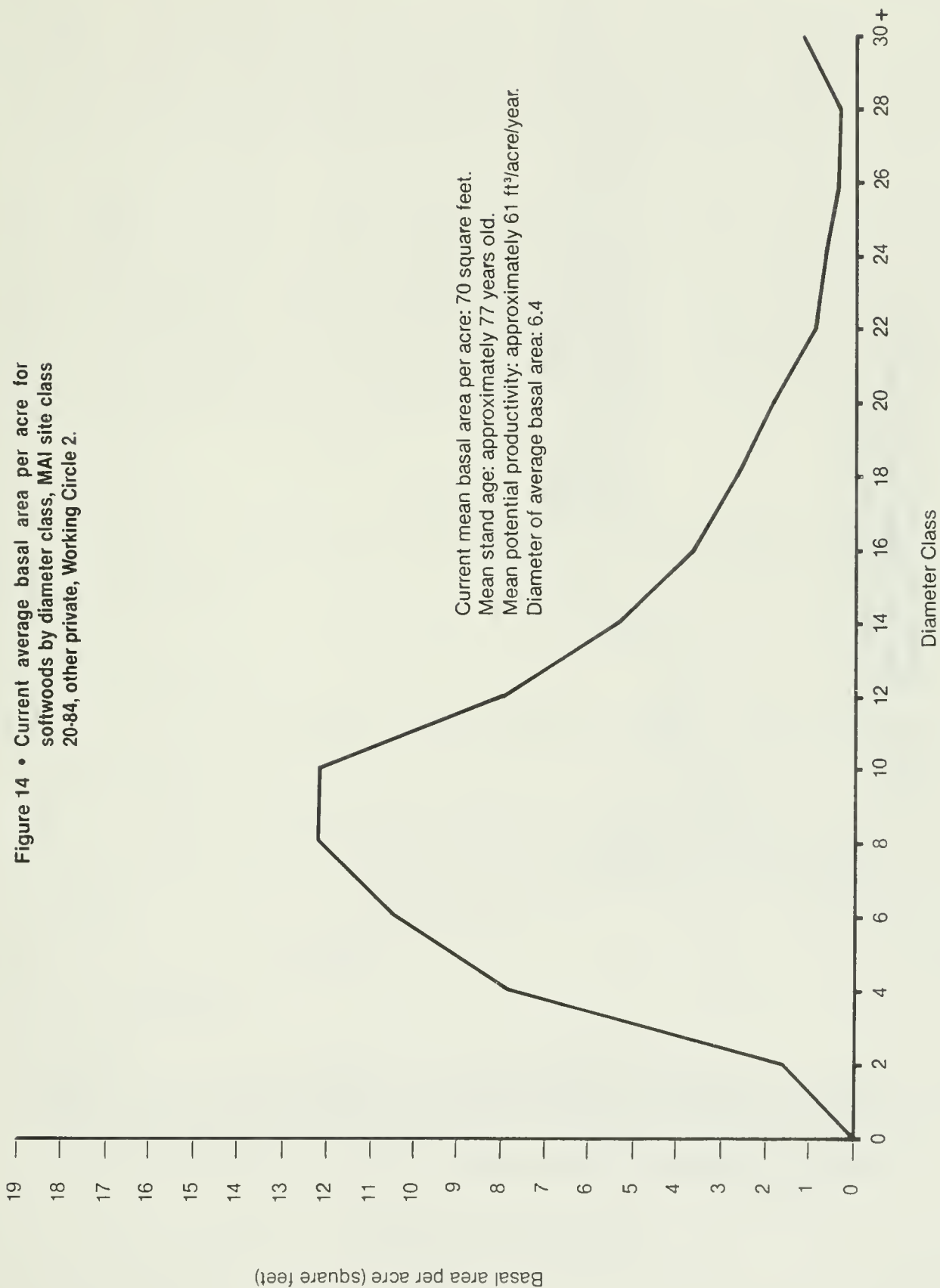
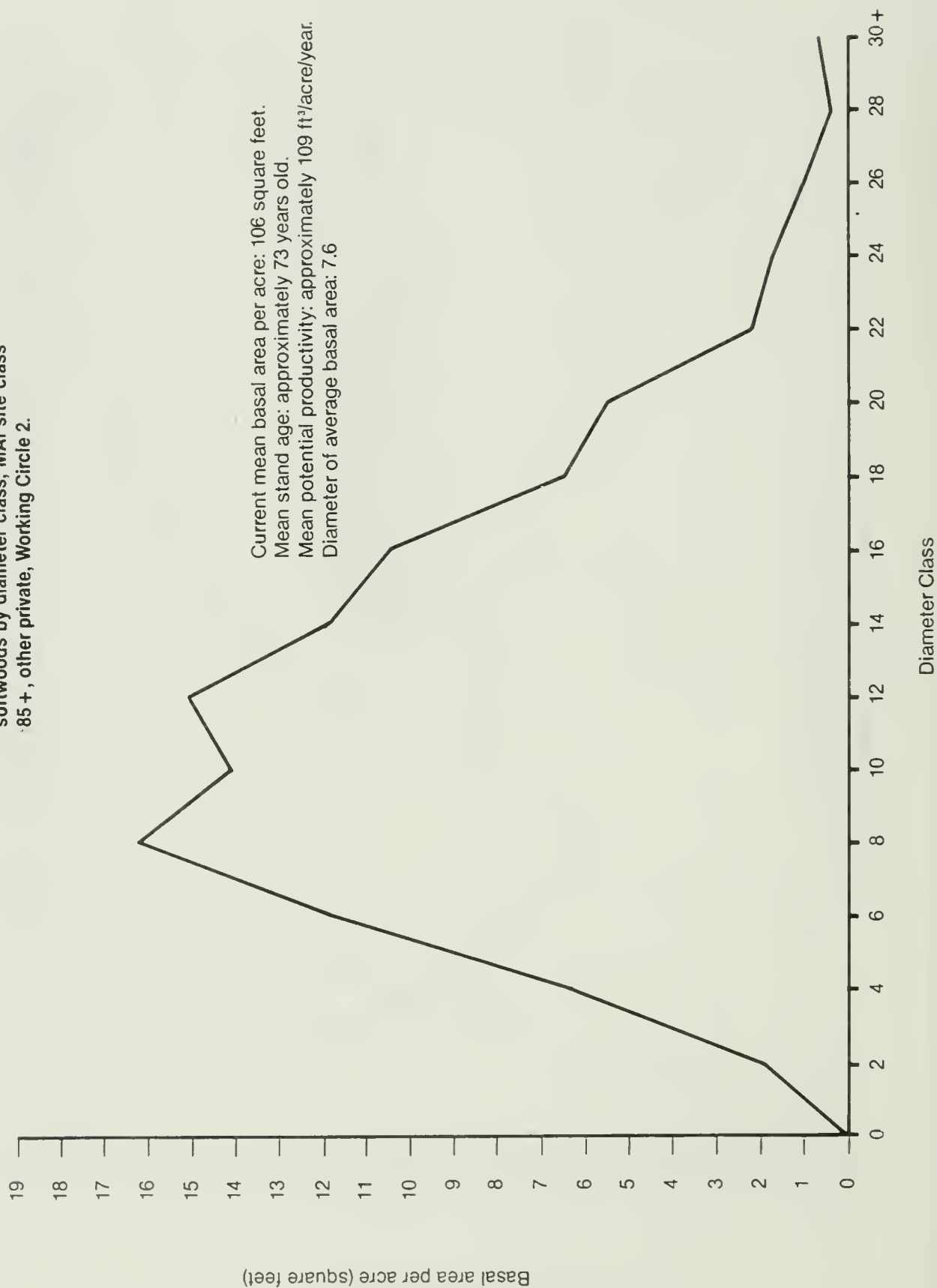


Figure 15 • Current average basal area per acre for softwoods by diameter class, MAI site class 85+, other private, Working Circle 2.



## Timberland Quality Class

Approximately 62 percent, or 540,500 acres, of the commercial softwood timberland in the working circle was rated as good or excellent for timber production based on a classification system developed for Montana. The other private ownership group had 71 percent of its timberland rated as excellent or good, the greatest amount among ownership groups on a percentage basis.

Timberland quality classes in this analysis are used to rate commercial timberlands according to their relative value for producing timber. The rankings are based primarily on factors that indicate the operability and productivity of the forest. Four quality classes -- excellent, good, fair, and poor -- were used. To avoid confusing the findings of this timberland rating effort with those of other state and federal land management agencies, the term "prime timberlands" was not used.

### Class Definitions

The criteria used to place timberlands into the appropriate quality classes are as follows:

#### Excellent timberlands

- have a potential productivity that is greater than or equal to 85 cubic feet per acre per year
- have a slope that is less than or equal to 40 percent
- have a good (class I) or medium (class II) landscape stability rating
- are less than or equal to 7,000 feet in elevation (west of the Continental Divide)

#### Good timberlands

- do not meet the requirements for excellent timberlands
- have a potential productivity that is greater than or equal to 50 cubic feet per acre per year
- have a good (class I) or medium (class II) landscape stability rating

- have a slope that is less than or equal to 40 percent if potential productivity is less than 85 cubic feet per acre per year
- are less than or equal to 7,000 feet in elevation (west of the Continental Divide)

#### Fair timberlands

- do not meet the requirements for good or excellent timberlands
- have a potential productivity that is greater than or equal to 20 cubic feet per acre per year
- have a slope that is less than or equal to 56 percent
- have a good (class I) or medium (class II) landscape stability rating
- are less than or equal to 8,000 feet in elevation

#### Poor timberlands

- do not meet the requirements for excellent, good, or fair timberlands

#### Timberland Quality Class and Stand Size Class

About 76 percent of the young-growth sawtimber stands were found on excellent or good rated timberlands. An estimated 48 percent of the old-growth sawtimber stands and 57 percent of the seedling-sapling stands were found on excellent or good rated timberlands (see figure 16).

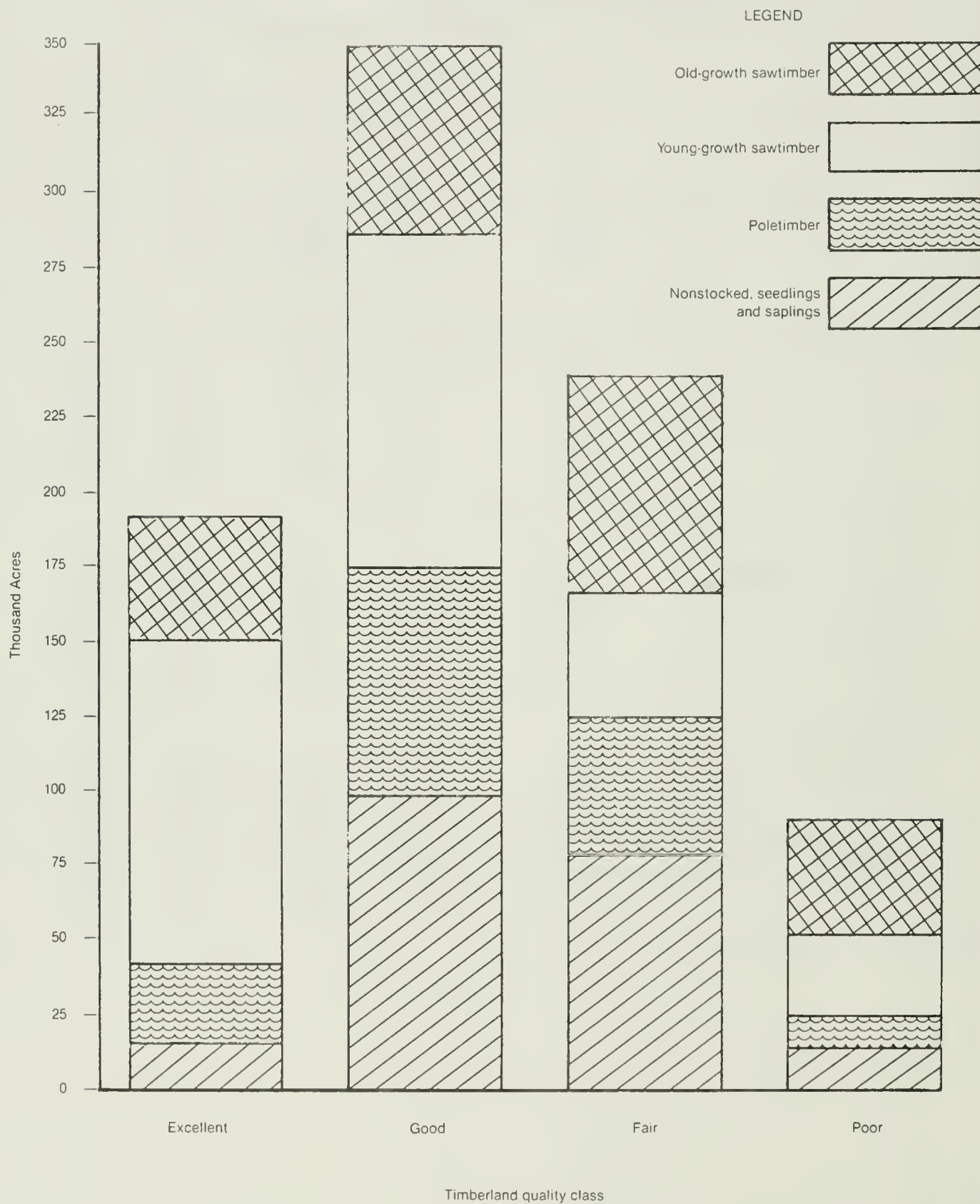
Seventy-one percent of the commercial softwood timberland in the other private ownership group was in either the excellent or good timberland quality class. This compares to 65 percent of the state and other public land, 57 percent of the forest industry land, and a 62 percent average for the whole working circle (see table 29). Ten percent of the timberland, or 89,200 acres, was rated as poor for timber production.



Table 29. Area of commercial softwood timberland by ownership group, stand size class and timberland quality class, Working Circle 2, (thousand acres).

		Timberland Quality Class				
		Excellent	Good	Fair	Poor	Total
		-----thousand acres-----				
State and Other Public						
Stand Size Class						
Old growth sawtimber		4.7	9.8	14.5	4.4	33.4
Young growth sawtimber		25.0	17.0	7.7	3.8	53.5
Poletimber		2.7	10.0	7.0	0.5	20.2
Seedlings and saplings		3.9	6.8	2.8	1.3	14.8
Nonstocked		-	0.8	1.8	0.2	2.8
Total		36.3	44.3	33.9	10.1	124.7
Forest Industry						
Stand Size Class						
Old growth sawtimber		28.9	41.6	39.1	25.6	135.1
Young growth sawtimber		33.5	46.2	24.5	16.6	120.8
Poletimber		8.6	39.6	28.2	5.5	81.9
Seedlings and saplings		8.4	56.4	52.3	8.2	125.2
Nonstocked		-	5.5	6.5	-	12.0
Total		79.3	189.2	150.5	55.9	475.0
Other Private						
Stand Size Class						
Old growth sawtimber.		7.6	11.6	18.9	8.2	46.3
Young growth sawtimber		51.5	48.9	10.5	7.4	118.2
Poletimber		13.6	25.2	9.8	3.7	52.3
Seedlings and saplings		3.2	28.1	13.5	2.8	47.6
Nonstocked		-	1.7	1.5	1.1	4.3
Total		75.9	115.4	54.1	23.2	268.6
Working Circle Totals						
Stand Size Class						
Old growth sawtimber		41.2	62.9	72.5	38.2	214.7
Young growth sawtimber		109.9	112.1	42.7	27.8	292.5
Poletimber		25.0	74.8	45.0	9.6	154.4
Seedlings and saplings		15.5	91.2	68.6	12.3	187.6
Nonstocked		-	8.0	9.9	1.2	19.1
Total		191.5	349.0	238.6	89.2	868.3

Figure 16. Area of commercial softwood timberland by stand size class and timberland quality class, Working Circle 2.



## Silvicultural Treatment Opportunities

The DSL, Forestry Division, developed a procedure to analyze data recorded on the field location that would place the sampled stand into one of several categories. Each of these categories represented a set of silvicultural treatment opportunities. As a result of this analysis it was determined that 70 percent of the commercial timberland offered silvicultural treatment opportunities to improve the forest's condition and ultimately increase timber yields. An estimated 399,800 acres, or 46 percent of the commercial softwood timberland, were placed into categories that imply silvicultural treatment opportunities other than harvest are available. When silvicultural treatment opportunity by timberland quality class was investigated it was discovered that the leading individual treatment opportunities existing on excellent and good timberlands were: harvest--high risk (123,600 acres), overstory removal (92,500 acres), precommercial thinning (86,200 acres), no treatment due to productive condition (72,700 acres) and regeneration of understocked areas (68,200 acres).

The Forestry Division has developed a procedure for using forest inventory data to assess silvicultural treatment opportunities. As a part of this procedure, 12 treatment opportunity categories were selected, each representing a group of stands with similar characteristics. Each category was given a treatment code number and a treatment name, such as "20--Precommercial thinning."

Despite its appearance, a treatment name does not prescribe a treatment -- it is merely a label for a group of stands that exhibit common characteristics. These characteristics differentiate one group of stands from another. Although these labels have a silvicultural basis, the limited amount of stand data used to derive these categories restricts the use of the process to planning.

To some degree, the treatment names used here reflect the forest management policies of the Forestry Division since different stand conditions and forestry goals demand different management techniques. Other forest managers might apply different names to these categories, or possibly combine two or more of them under a single heading, depending on their management objectives.

Table 30. Treatment opportunity code definitions for tables 31, 32, 33, 34, and 35.

10	Harvest - high risk
11	Harvest - low risk
12	Commercial thinning
13	Overstory removal
14	Two storied stand (overstory: harvest - high risk, understory: manageable)
15	Two storied stand (overstory: harvest - low risk, understory: manageable)
20	Precommercial thinning
21	Stand conversion
22	Sanitation
23	Regeneration of understocked areas
30	No treatment due to productive condition
32	No treatment inoperable
33	No treatment deferred until merchantable
40	Unknown - poor crowns, good growth

#### No Overlap

12, 13	Commercial thinning, overstory removal
13, 20	Overstory removal, precommercial thinning
13, 20, 23	Overstory removal, precommercial thinning, regeneration of understocked areas
13, 21	Overstory removal, stand conversion
13, 23	Overstory removal, regeneration of understocked areas
13, 33	Overstory removal, no treatment deferred until merchantable
20, 23	Precommercial thinning, regeneration of understocked areas
22, 23	Sanitation, regeneration of understocked areas
22, 33	Sanitation, no treatment deferred until merchantable

#### Possible Overlap

12, 13, 22	Commercial thinning, overstory removal, sanitation
12, 22	Commercial thinning, sanitation
13, 20, 22	Overstory removal, precommercial thinning, sanitation
13,20,22,23	Overstory removal, precommercial thinning, sanitation, regeneration of understocked areas
13, 22	Overstory removal, sanitation
13, 22, 23	Overstory removal, sanitation, regeneration of understocked areas
13, 22, 33	Overstory removal, sanitation, no treatment deferred until merchantable
20, 22	Precommercial thinning, sanitation
20, 22, 23	Precommercial thinning, sanitation, regeneration of understocked areas

Table 31. Area of commercial softwood timberland by treatment opportunity group and MAI site class, Working Circle 2, (thousand acres).

Treatment Opportunity Group	Site Class (Ft <sup>3</sup> /acre/year)					All Classes
	20-49	50-84	85-119	120-164	165+	
	-----thousand acres-----					
10	24.1	123.4	43.7	4.1	-	195.2
11	19.4	63.1	24.8	5.6	-	112.9
12	-	-	-	1.3	-	1.3
13	5.6	13.7	8.5	6.6	-	34.3
14	4.1	6.4	-	-	-	10.5
15	-	1.3	-	2.9	-	4.3
20	13.0	40.2	16.8	-	-	70.0
21	-	28.5	3.8	1.6	-	33.9
22	2.7	24.3	12.2	-	-	39.2
23	23.4	43.6	7.8	0.7	-	75.6
30	18.6	59.3	24.8	13.6	-	116.3
32	-	-	-	-	-	-
33	-	5.7	2.9	-	-	8.6
40	-	15.4	5.3	-	-	20.7
12,13	-	-	4.2	-	-	4.2
13,20	7.4	19.9	5.5	-	-	32.8
13,20,23	-	0.7	-	-	-	0.7
13,21	2.3	9.9	1.6	-	-	13.8
13,23	2.7	5.0	5.6	2.8	-	16.1
13,33	0.7	4.2	-	-	-	5.0
20,23	2.8	8.4	2.5	-	-	13.7
22,23	2.7	5.4	-	-	-	8.1
22,33	-	2.9	-	-	-	2.9
12,13,22	-	-	-	-	-	-
12,22	-	-	-	-	-	-
13,20,22	2.8	-	2.9	-	-	5.7
13,20,22,23	-	-	-	-	-	-
13,22	1.3	8.2	5.4	-	-	14.8
13,22,23	-	-	-	2.3	-	2.3
13,22,33	-	0.6	1.3	-	-	1.9
20,22	10.2	4.1	5.6	-	-	19.8
20,22,23	-	3.8	-	-	-	3.8
Total	143.7	497.9	185.2	41.5	-	868.3

#### Treatment Code Definitions

Table 30 lists the treatment opportunities and their code numbers. The list is divided into three groups. The first consists of the individual treatments. The other two list possible combined treatments, which are of two types: those that do not overlap and those that may. The combined codes listed under the "possible overlap" group represent treatments that may



Table 32. Area of commercial softwood timberland by treatment opportunity group and timberland quality class, Working Circle 2, (thousand acres).

Treatment Opportunity Group	Timberland Quality Class				Total
	Excellent	Good	Fair	Poor	
	-----thousand acres-----				
10	42.3	81.3	42.2	29.4	195.2
11	25.0	34.5	34.8	18.6	112.9
12	1.3	-	-	-	1.3
13	15.1	10.9	8.3	-	34.3
14	-	3.6	4.1	2.7	10.5
15	2.9	-	1.3	-	4.3
20	11.4	29.1	26.8	2.7	80.0
21	4.0	20.4	9.5	-	33.9
22	12.2	17.5	6.7	2.7	39.2
23	6.3	31.4	27.2	10.7	75.6
30	28.1	44.6	32.8	10.8	116.3
32	-	-	-	-	-
33	2.9	5.7	-	-	8.6
40	5.3	9.7	5.6	-	20.7
12,13	4.2	-	-	-	4.2
13,20	5.5	16.3	8.3	2.7	32.8
13,20,23	-	0.7	-	-	0.7
13,21	1.6	8.5	3.6	-	13.8
13,23	8.3	2.7	2.7	2.3	16.1
13,33	-	4.2	0.7	-	5.0
20,23	2.5	8.4	2.8	-	13.7
22,23	-	5.4	2.7	-	8.1
22,33	-	2.9	-	-	2.9
12,13,22	-	-	-	-	-
12,22	-	-	-	-	-
13,20,22	2.9	-	2.8	-	5.7
13,20,22,23	-	-	-	-	-
13,22	5.4	4.1	2.6	2.7	14.8
13,22,23	-	-	-	2.3	2.3
13,22,33	1.3	0.6	-	-	1.9
20,22	2.9	4.1	12.8	-	19.8
20,22,23	-	2.5	-	1.3	3.8
Total	191.5	349.0	238.6	89.2	868.3

overlap each other during actual treatment. For example, the combined treatment code 13, 20, 22 suggests that a certain stand needs a treatment, or treatments, that will remove the overstory (13), precommercially thin (20), and sanitize the stand (22). Two or more of these needs might be met in one step. Sanitation may be partially met by precommercial thinning, or it may be partially or completely met by removing the overstory.

Table 33. Area of commercial softwood timberland by treatment opportunity group and timberland quality class, state and other public, Working Circle 2, (thousand acres).

Treatment Opportunity Group	Timberland quality Class				Total
	Excellent	Good	Fair	Poor	
	-----thousand acres-----				
10	5.4	8.5	5.4	3.3	22.5
11	4.6	7.5	6.0	0.5	18.5
12	1.3	-	-	-	1.3
13	2.1	0.7	0.8	-	3.6
14	-	0.9	1.4	-	2.3
15	0.3	-	1.3	-	1.7
20	2.6	1.7	1.4	-	5.7
21	0.1	1.7	1.4	-	3.2
22	1.5	2.3	1.5	-	5.3
23	1.0	2.8	4.8	2.4	10.9
30	2.7	6.0	2.5	1.9	13.1
32	-	-	-	-	-
33	0.2	0.3	-	-	0.6
40	4.2	1.7	0.3	-	6.2
12,13	1.6	-	-	-	1.6
13,20	3.2	1.3	0.9	-	5.4
13,20,23	-	*	-	-	*
13,21	0.1	0.6	1.8	-	2.5
13,23	0.6	-	-	0.4	1.0
13,33	-	1.6	*	-	1.6
20,23	0.2	0.5	-	-	0.7
22,23	-	2.7	-	-	2.7
22,33	-	0.3	-	-	0.3
12,13,22	-	-	-	-	-
12,22	-	-	-	-	-
13,20,22	0.2	-	-	-	0.2
13,20,22,23	-	-	-	-	-
13,22	2.6	1.3	2.6	-	6.6
13,22,23	-	-	-	0.4	0.4
13,22,33	1.3	0.6	-	-	1.9
20,22	0.3	1.3	2.0	-	3.6
20,22,23	-	0.2	-	1.3	1.5
Total	36.3	44.3	33.9	10.1	124.7

\*Indicates less than 50 acres.

Understanding that some treatments may be handled simultaneously is important when allocating funds, equipment, and manpower for timber stand improvement projects. Estimates of costs and work loads may be reduced for acreages on which treatments may overlap.

For further information about the kinds of stands represented by each treatment code, see Appendix 5.

Table 34. Area of commercial softwood timberland by treatment opportunity group and timberland quality class, forest industry, Working Circle 2, (thousand acres).

Treatment Opportunity Group	Timberland Quality Class				
	Excellent	Good	Fair	Poor	Total
	-----thousand acres-----				
10	23.8	49.6	28.2	20.0	121.6
11	13.7	19.1	20.8	14.1	67.7
12	-	-	-	-	-
13	6.4	6.3	5.5	-	18.3
14	-	2.7	2.7	2.7	8.2
15	-	-	-	-	-
20	5.6	19.5	16.5	2.7	44.4
21	0.5	14.6	8.1	-	23.3
22	9.0	4.1	3.5	2.7	19.3
23	2.9	14.0	14.8	6.3	38.0
30	11.4	25.2	19.2	-	55.8
32	-	-	-	-	-
33	-	2.7	-	-	2.7
40	-	5.5	2.7	-	8.2
12,13	-	-	-	-	-
13,20	-	8.3	5.6	2.7	16.6
13,20,23	-	0.1	-	-	0.1
13,21	0.1	2.7	0.9	-	3.7
13,23	3.0	2.7	2.7	0.9	9.4
13,33	-	-	0.1	-	0.1
20,23	0.2	3.5	2.8	-	6.5
22,23	-	2.7	2.7	-	5.4
22,33	-	-	-	-	-
12,13,22	-	-	-	-	-
12,22	-	-	-	-	-
13,20,22	-	-	2.8	-	2.8
13,20,22,23	-	-	-	-	-
13,22	2.7	2.7	-	2.7	8.2
13,22,23	-	-	-	0.9	0.9
13,22,33	-	-	-	-	-
20,22	-	2.7	10.9	-	13.6
20,22,23	-	0.2	-	-	0.2
Total	79.3	189.2	150.5	55.9	475.0

#### Treatment Opportunities by Ownership Group and Site Class

Five codes indicate no immediate treatments are needed. These are: (11 and 15) harvest--low risk, (30) no treatment due to productive condition, (33) no treatment, deferred until merchantable, and (40) unknown--poor crowns, good growth. In Working Circle 2, approximately 262,800 acres, or

Table 35. Area of commercial softwood timberland by treatment opportunity group and timberland quality class, other private, Working Circle 2, (thousand acres).

Treatment Opportunity Group	Timberland Quality Class				Total
	Excellent	Good	Fair	Poor	
	-----thousand acres-----				
10	13.2	23.2	8.5	6.2	51.1
11	6.7	7.9	8.0	4.1	26.7
12	-	-	-	-	-
13	6.6	3.9	2.3	-	12.8
14	-	-	-	-	-
15	2.6	-	-	-	2.6
20	3.2	7.9	8.9	-	20.0
21	3.4	4.1	-	-	7.4
22	1.8	11.1	1.8	-	14.7
23	2.4	14.6	7.6	2.0	26.7
30	14.0	13.4	11.1	9.0	47.4
33	2.7	2.6	-	-	5.2
40	1.1	2.6	2.6	-	6.3
12,13	2.7	-	-	-	2.7
13,20	2.3	6.6	1.8	-	10.7
13,20,23	-	0.6	-	-	0.6
13,21	1.4	5.2	0.9	-	7.6
13,23	4.8	-	-	0.9	5.7
13,33	-	2.7	0.6	-	3.3
20,23	2.1	4.4	-	-	6.5
22,23	-	-	-	-	-
22,33	-	2.6	-	-	2.6
12,13,22	-	-	-	-	-
12,22	-	-	-	-	-
13,20,22	2.7	-	-	-	2.7
13,20,22,23	-	-	-	-	-
13,22	-	-	-	-	-
13,22,23	-	-	-	0.9	0.9
13,22,33	-	-	-	-	-
20,22	2.6	-	-	-	2.6
20,22,23	-	2.1	-	-	2.1
Total	75.9	115.4	54.1	23.2	268.6

about 30 percent of the commercial softwood timberlands, were placed into these treatment categories (see table 31). An additional 205,700 acres were placed into harvest--high risk. The remaining 399,800 acres, or 46 percent of the commercial softwood timberlands, were placed into categories that imply silvicultural treatment opportunities are available. If stands in the harvest -- high risk category (10 and 14) are added, the total amount of commercial

softwood timberland that could use some type of silvicultural treatment becomes 605,500 acres, or 70 percent of all softwood timberlands inventoried.

This does not mean that all of these acres should be treated. Because of the costs involved and possible nontimber resource considerations, it may not be advisable to apply the indicated treatments to some stands. Nevertheless, this total acreage figure is important because it helps to illustrate the overall condition of the forest. It also partially explains why current net growth in the working circle averages 42 cubic feet per acre per year less than potential net growth. These opportunities can be viewed with optimism if forest managers plan to take advantage of them to increase the health and vigor (productivity) of the forest.

About 70 percent of the timberlands owned by all three ownership groups offered treatment opportunities. If lands in the harvest--high risk categories (10 and 14) are subtracted from the total number of acres offering silvicultural treatment opportunities, an estimate of the number of acres offering treatment opportunities other than harvesting can be made. Such a calculation shows 43 percent (210,800 acres) of forest industry land, 48 percent (129,300 acres) of other private land, and 48 percent (59,800 acres) of state and other public lands offered treatment opportunities in addition to harvesting.

#### Silvicultural Treatment Opportunities by Timberland Quality Class

Forest managers usually consider a stand's potential economic return before applying silvicultural treatments. Potential productivity and operability of the land are important factors in determining the possible economic return realized from forest management activities. Therefore, a table that estimates acreage by timberland quality class and treatment opportunity class can be helpful by showing how many acres are likely to be economical to treat. Obviously, timber management funds are more likely to be spent on timberlands rated as good or excellent than on timberlands of lesser quality.

The amounts of land in the different timberland quality classes that were assigned to the different treatment opportunities are shown in table 36. These acreages are shown for the working circle as a whole, as well as for the different ownership groups.



In Working Circle 2, the treatment opportunity with the largest amount of good or excellent quality timberland at the time of the inventory was harvest --high risk. This treatment opportunity existed on 123,600 acres of these more productive lands. The category with the second highest amount of acreage was no treatment due to productive condition with 72,700 acres.

As shown in table 32, large amounts of high quality timberland also fell into four other treatment opportunity categories:

11--harvest--low risk (59,500 acres)

20--precommercial thinning (40,500 acres)

23--regeneration of understocked areas (37,700 acres)

22--sanitation (29,700 acres)

Another way to view treatment opportunities is to break the combined treatment codes into their component treatment codes and assign each code the total acreage figure. For example, if 10,000 acres are assigned the "13, 20--overstory removal and precommercial thinning" combined treatment code, then 10,000 acres present opportunities for overstory removal and 10,000 acres present opportunities for precommercial thinning. By adding the acreages assigned to the individual codes it is possible to determine the amount of land offering opportunities for each type of treatment. Table 36 shows the total number of acres assigned to each treatment opportunity class. The table also shows the amounts of land in the different timberland quality classes that were assigned to the different treatment opportunity classes. These amounts are shown for the working circle as a whole, as well as for the different ownership groups (see tables 36 through 39).

Because they are not combined with any other treatments, the number of acres in the harvest--high risk and harvest--low risk groups does not change in the treatment class tables. If these "harvest" groups are ignored, the most commonly assigned treatment opportunity classes for excellent and good-rated timberlands in Working Circle 2 were overstory removal (92,500 acres), precommercial thinning (86,200 acres), no treatment due to productive condition (72,700 acres), and regeneration of understocked areas (68,200 acres).

Table 36. Area of commercial softwood timberland by treatment class and timberland quality class, Working Circle 2, (thousand acres).

Treatment Class	Timberland Quality Class				Total
	Excellent	Good	Fair	Poor	
	-----thousand acres-----				
Harvest--high risk	42.3	81.3	42.2	29.4	195.2
Harvest--low risk	25.0	34.5	34.8	18.6	112.9
Commercial thinning	5.6	-	-	-	5.6
Overstory removal	44.4	48.1	29.1	10.1	131.6
Two storied stand:	-	3.6	4.1	2.7	10.5
Overstory, harvest--high risk					
Understory, manageable					
Two storied stand:	2.9	-	1.3	-	4.3
Overstory, harvest--low risk					
Understory, manageable					
Precommercial thinning	25.2	61.0	53.5	6.8	146.5
Stand conversion	5.6	28.9	13.1	-	47.7
Sanitation	24.7	37.1	27.7	9.1	98.6
Regeneration of understocked areas	17.1	51.1	35.4	16.6	120.3
No treatment due to productive condition	28.1	44.6	32.8	10.8	116.3
No treatment--inoperable	-	-	-	-	-
No treatment--deferred until merchantable	4.2	13.4	0.7	-	18.3
Unknown--poor crowns, good growth	5.3	9.7	5.6	-	20.7

Table 37. Area of commercial softwood timberland by treatment class and timberland quality class, state and other public, Working Circle 2, (thousand acres).

Treatment Class	Timberland Quality Class				Total
	Excellent	Good	Fair	Poor	
	-----thousand acres-----				
Harvest--high risk	5.4	8.5	5.4	3.3	22.5
Harvest--low risk	4.6	7.5	6.0	0.5	18.5
Commercial thinning	2.9	-	-	-	2.9
Overstory removal	11.7	6.1	5.9	0.9	24.7
Two storied stand:	-	0.9	1.4	-	2.3
Overstory, harvest--high risk					
Understory, manageable					
Two storied stand:	0.3	-	1.3	-	1.7
Overstory, harvest--low risk					
Understory, Manageable					
Precommercial thinning	6.6	5.0	4.3	1.3	17.3
Stand conversion	0.3	2.2	3.2	-	5.7
Sanitation	6.0	8.8	6.1	1.7	22.6
Regeneration of understocked areas	1.8	6.2	4.8	4.6	17.3
No treatment due to productive condition	2.7	6.0	2.5	1.9	13.1
No treatment--inoperable	-	-	-	-	-
No treatment--deferred until merchantable	1.5	2.8	*	-	4.4
Unknown--poor crowns, good growth	4.2	1.7	0.3	-	6.2

\*Indicates less than 50 acres.

Table 38. Area of commercial softwood timberland by treatment class and timberland quality class, forest industry, Working Circle 2, (thousand acres).

Treatment Class	Timberland Quality Class				Total
	Excellent	Good	Fair	Poor	
	-----thousand acres-----				
Harvest--high risk	23.8	49.6	28.2	20.0	121.6
Harvest--low risk	13.7	19.1	20.8	14.1	67.7
Commercial thinning	-	-	-	-	-
Overstory removal	12.3	22.9	17.5	7.3	60.0
Two storied stand:	-	2.7	2.7	2.7	8.2
Overstory, harvest--high risk					
Understory, manageable					
Two storied stand:	-	-	-	-	-
Overstory, harvest--low risk					
Understory, manageable					
Precommercial thinning	5.8	34.4	38.5	5.5	84.2
Stand conversion	0.6	17.3	9.0	-	27.0
Sanitation	11.7	12.5	19.8	6.4	50.4
Regeneration of understocked areas	6.1	23.3	23.0	8.2	60.6
No treatment due to	11.4	25.2	19.2	-	55.8
productive condition					
No treatment--inoperable	-	-	-	-	-
No treatment--deferred	-	2.7	0.1	-	2.8
until merchantable					
Unknown--poor crowns,	-	5.5	2.7	-	8.2
good growth					

Table 39. Area of commercial softwood timberland by treatment class and timberland quality class, other private, Working Circle 2, (thousand acres).

Treatment Class	Timberland Quality Class				Total
	Excellent	Good	Fair	Poor	
	-----thousand acres-----				
Harvest--high risk	13.2	23.2	8.5	6.2	51.1
Harvest--low risk	6.7	7.9	8.0	4.1	26.7
Commercial thinning	2.7	-	-	-	2.7
Overstory Removal	20.4	19.0	5.6	1.9	46.9
Two storied stand:	-	-	-	-	-
Overstory, harvest--high risk					
Understory, manageable					
Two storied stand:	2.6	-	-	-	2.6
Overstory, harvest--low risk					
Understory, manageable					
Precommercial thinning	12.8	21.6	10.7	-	45.0
Stand conversion	4.8	9.3	0.9	-	15.0
Sanitation	7.1	15.7	1.8	0.9	25.5
Regeneration of understocked areas	9.2	21.7	7.6	3.9	42.4
No treatment due to	14.0	13.4	11.1	9.0	47.4
productive condition					
No treatment--inoperable	-	-	-	-	-
No treatment--deferred	2.7	7.8	0.6	-	11.1
until merchantable					
Unknown--poor crowns,	1.1	2.6	2.6	-	6.3
good growth					

## AVAILABLE TIMBER

An analysis of timber availability based on many of the factors that affect timber management shows timber yields in Working Circle 2 may be reduced by 17 percent due to nontimber use constraints.

A difficult and potentially expensive task in any forest inventory is determining the amount of timber that is actually available for harvesting. Every acre of state and private forest land is not available for continuous timber harvesting and probably will never be unless wood becomes much more valuable.

The first step in assessing timber availability is to group the forest land into availability classes. This is done based on various combinations of land use influence zones, ownership groups, and topographic characteristics. Some of the criteria used to delineate availability classes include water influence zones, travel influence zones, slope percent, and elevation. These availability classes are then assigned to one of three land classes based on each land class's definition and the characteristics of the different availability classes. Table 40 shows the criteria used to assess timber availability in Working Circle 2.

### Land Classes

The commercial forest land in Working Circle 2 was grouped into three land classes (Green 1976):

1. Standard: land available and operable now that is not subject to any nontimber use impacts that might affect timber growing costs or expected yields;
2. Special: land available and operable now, but with ecological or other use constraints that might affect the cost of growing timber, expected yield, or both; and
3. Marginal: land potentially available and operable, or both, but not now expected to be harvested because of excessive development costs, low product returns, or resource protection constraints.

## Availability Classes

An availability class was designated for the different types of land included in each land class. Using standard land as Availability Class I, where full yields can be expected to be available, other availability classes were defined as a percentage of the standard land yields expected, considering the impacts of other uses.

In this manner, it was possible to estimate the amount that timber yields would be reduced because of nontimber use constraints. For Working Circle 2, this amount proved to be equivalent to reducing the commercial forest land area by 17 percent.

Table 41 shows the amount of land in each land class.

Table 40. Availability class definitions and components.

<u>Land Class</u>	<u>Availability Class</u>	<u>% of Standard Land Yield Expected</u>	<u>Definition</u>
Standard	I	100	Standard land definition
Special	I	100	Big game winter range
Special	II	90	Travel and municipal influence zone
Special	III	75	Ski resort, recreation, and subdivision influence zones
Special	IV	50	Water influence zones and other private individual owner
Special	V	0	Subdivided land, State Department of Fish, Wildlife and Parks and miscellaneous Federal land
Marginal	IV	50	Steep slopes (greater than 64%); all land greater than 8,000 feet in elevation; all land that has a landscape stability class rating of III



Table 41. Area of commercial timberland by land class, and productivity class, Working Circle 2, (thousand acres).

Availability Class	Productivity Class Ft <sup>3</sup> /Acre/Year	Land Class			
		Standard	Special	Marginal	Total
		-----thousand acres-----			
I	20 - 49	48.1	26.3	-	74.3
	50 - 84	150.8	99.8	-	250.6
	85 - 119	54.7	38.0	-	92.7
	120 - 164	10.2	8.3	-	18.5
	165+	-	-	-	-
	Total	263.8	172.3	-	436.2
II	20 - 49	-	30.2	-	30.2
	50 - 84	-	101.6	-	101.6
	85 - 119	-	37.0	-	37.0
	120 - 164	-	7.8	-	7.8
	165+	-	-	-	-
	Total	-	176.6	-	176.6
III	20 - 49	-	5.4	-	5.4
	50 - 84	-	18.5	-	18.5
	85 - 119	-	7.5	-	7.5
	120 - 164	-	1.7	-	1.7
	165	-	-	-	-
	Total	-	33.0	-	33.0
IV	20 - 49	-	24.2	12.7	36.9
	50 - 84	-	80.7	41.6	122.3
	85 - 119	-	36.4	15.5	51.9
	120 - 164	-	9.0	3.4	12.3
	165+	-	-	-	-
	Total	-	150.3	73.1	223.4
V	20 - 49	-	1.5	-	1.5
	50 - 84	-	8.2	-	8.2
	85 - 119	-	3.5	-	3.5
	120 - 164	-	1.1	-	1.1
	165+	-	-	-	-
	Total	-	14.3	-	14.3
Total all classes		263.8	546.5	73.1	883.5

## INVENTORY DATA BY COUNTY

### Area by Owner

Two-thirds of the land in Working Circle 2 was under public ownership. Ownership patterns varied between counties, however. For example, more than a fourth of Missoula County was owned by forest industries, while less than two percent of Ravalli County was. About 50 percent of the sampled land in both Mineral and Missoula Counties belonged to forest industries. Seven-eighths of the sampled land in Ravalli County belonged to other private owners. More than half of the other (noncommercial) timberland sampled was found in Ravalli County.

At the time of inventory, public land made up two-thirds of Working Circle 2, but there was a great deal of variation between the counties (see table 42). Just over half of Missoula County was public land, while Ravalli County was three-fourths publicly owned, and Mineral County was seven-eighths. Missoula County had all of the Bureau of Indian Affairs land in the working circle, and was the only county with any Bureau of Land Management land to speak of. Although Mineral County is less than half as big as Missoula County, it had almost as much Forest Service land. Ravalli County had close to twice as much Forest Service land as Mineral County, Missoula County had about twice as high a percentage of state land as the other two counties, and Ravalli County had the only miscellaneous federal land.

Ravalli County had the most other private (other than forest industry) land in the working circle, and only 1.4 percent of the total area was owned by a forest industry. Missoula County had the most forest industry land. Only 13.6 percent of Mineral County is privately owned.

When considering only sampled land, the percentages are naturally much higher and more meaningful. Mineral County had the highest percentage of state land even though it has by far the smallest area of state land. Missoula County had seven-and-a-half times as much forest industry land as Mineral County, but the percentages of the total sampled area in each county were not much different. Only about five percent of the sampled land in Ravalli County was owned by a forest industry. Just over a third of the sampled land in Mineral and Missoula Counties belonged to other private owners. Almost seven-eighths of the sampled land in Ravalli County was other private, although the actual number of acres was not much higher than in Missoula County.

Table 42. Total land area by owner and county, Working Circle 2, (acres).

Owner	Mineral				County				Total			
	Missoula		Ravalli		Total		Total					
	Acreage	%	Acreage	%	Acreage	%	Acreage	%				
Public:												
USDA Forest Service	647,207	83.2	676,742	40.9	1,109,425	72.7	2,433,374	61.5				
USDI Bureau of Indian Affairs	-	-	94,392	5.7	-	-	94,392	2.4				
USDI Bureau of Land Management	-	-	25,923	1.6	40	*	25,963	0.6				
Miscellaneous Federal	-	-	-	-	2,692	0.2	2,692	0.1				
State	24,667	3.2	98,483	6.0	40,929	2.7	164,079	4.1				
County and Municipal	160	*	1,425	0.1	490	*	2,075	0.1				
Subtotal	672,034	86.4	896,965	54.3	1,153,576	75.6	2,722,575	68.8				
Private:												
Forest industry	59,497	7.6	449,398	27.2	21,428	1.4	530,323	13.4				
Other private	46,683	6.0	306,296	18.5	350,865	23.0	703,844	17.8				
Subtotal	106,180	13.6	755,694	45.7	372,293	24.4	1,234,167	31.2				
Total	778,214	100.0	1,652,659	100.0	1,525,869	100.0	3,956,742	100.0				

Table 43. Sampled land area by owner and county, Working Circle 2, (acres).

Owner	County						Total
	Mineral		Missoula		Ravalli		
	Acreage	%	Acreage	%	Acreage	%	Acreage
-----acres-----							
State	24,667	18.8	98,483	11.5	40,929	9.8	164,079
County and Municipal	160	0.1	1,425	0.2	490	0.1	2,075
Miscellaneous Federal	-	-	-	-	2,692	0.6	2,692
Forest Industry	59,497	45.4	449,398	52.5	21,428	5.2	530,323
Other Private	46,683	35.7	306,296	35.8	350,865	84.3	703,844
	<hr/>		<hr/>		<hr/>		<hr/>
Total	131,007	100.0	855,602	100.0	416,404	100.0	1,403,013
	<hr/>		<hr/>		<hr/>		<hr/>

\*Indicates less than 0.5 percent.

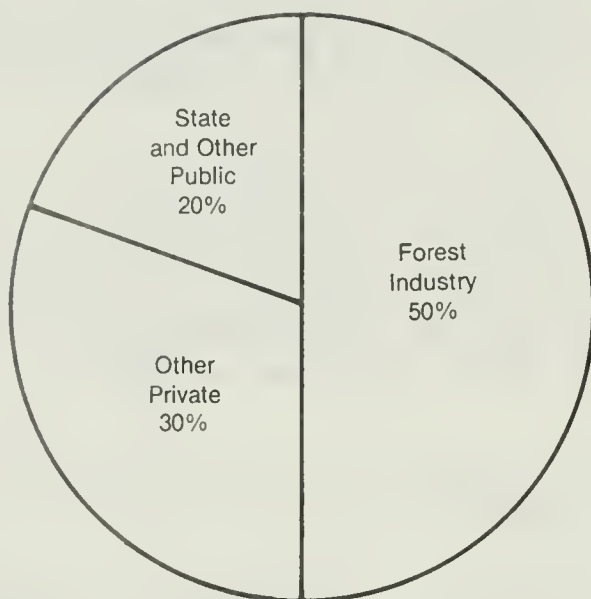
Figure 17 graphically displays the relative amount of sampled commercial timberland by ownership group for each county. The largest single percentage is the other private ownership group in Ravalli County. This is largely due to the small amount of forest industry land. In both Mineral and Missoula Counties, the highest percentage of sampled commercial timberland was owned by forest industries.

Half of the other timberland (unproductive) in Working Circle 2 is other private land in Ravalli County (see table 44). Forest industries and other private owners in Missoula County also owned a fair amount of other timberland, although it is a small percentage of the total timberland. In Mineral County, other private owners had the least sampled other timberland.

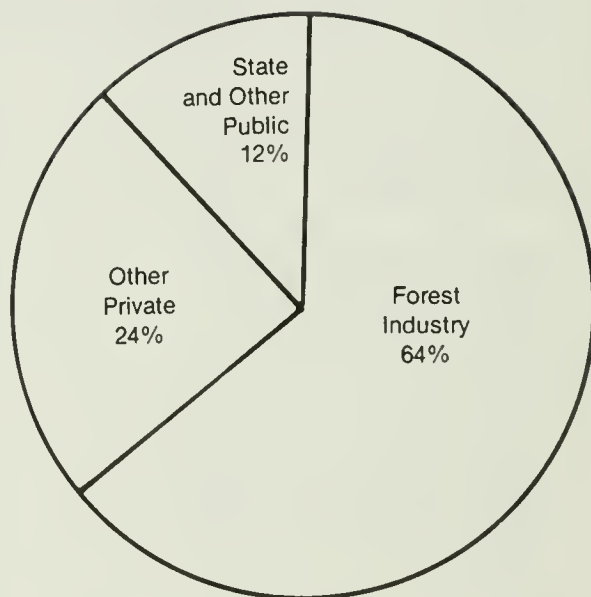
Table 44. Area of commercial and other timberland by county and ownership group, Working Circle 2, (thousand acres).

Ownership Group	Commercial Timberland	Other Timberland	Total Timberland
	-----thousand acres-----		
Mineral County			
State and other public	21.4	0.3	21.7
Forest industry	53.7	0.3	54.0
Other private	<u>33.0</u>	<u>0.1</u>	<u>33.1</u>
Total	108.1	0.6	108.8
Missoula County			
State and other public	79.4	0.1	79.5
Forest industry	407.7	0.6	408.3
Other private	<u>151.4</u>	<u>0.6</u>	<u>152.0</u>
Total	638.5	1.3	639.8
Ravalli County			
State and other public	25.5	0.1	25.6
Forest industry	16.9	0.1	17.0
Other private	<u>94.6</u>	<u>2.1</u>	<u>96.7</u>
Total	136.9	2.3	139.1
Working Circle Total	<u>883.5</u>	<u>4.2</u>	<u>887.7</u>

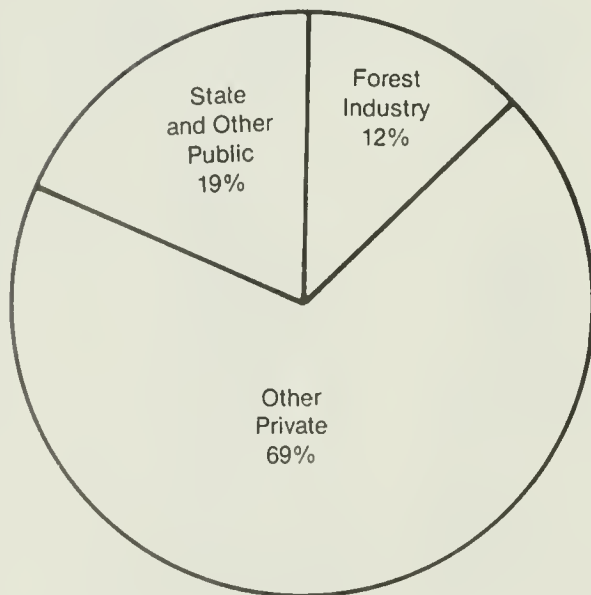
Figure 17. Proportion of sampled commercial timberland by ownership group for each county, Working Circle 2.



MINERAL



MISSOULA



RAVALLI



## Timber Resource

The Douglas-fir forest type covered the most area in each county. Likewise, Douglas-fir was the species with the most volume. Ravalli County had the most growth and least mortality per acre on sampled land. The leading silvicultural treatment opportunity in each county was harvest--high risk. On a percentage basis, Ravalli County had the largest amount of commercial softwood timberland offering silvicultural treatment opportunities -- other than harvest -- to improve the forest's production.

### Forest Type Acreage by Ownership Group

In each county in Working Circle 2, the Douglas-fir forest type covered more than twice as much area as the ponderosa pine type, which was the second most common (see tables 45 through 47). In Mineral and Missoula Counties, however, the other private ownership group had more area in the ponderosa pine forest type.

### Forest Type Volume by Ownership Group

Tables 48 through 53 give the volume of growing stock and sawtimber by forest type, ownership group, and county. Just as Douglas-fir was the most common forest type, it had the most volume in each county. The ponderosa pine forest type had the second most board foot volume in each county, but lodgepole pine had the second most cubic foot volume in Mineral and Missoula Counties. Ponderosa pine's higher board foot to cubic foot ratio was probably due to more large diameter trees on the ponderosa pine forest type. The total sampled volumes in each county are graphically displayed in figures 18 and 19.

Table 45. Area of commercial timberland by forest type and ownership group, Mineral County, Working Circle 2, (thousand acres).

Forest Type	Ownership Group			Total	Percentage of Total
	State and Other Public	Forest Industry	Other Private		
	-----thousand acres-----				
Douglas-fir	12.6	24.9	9.5	47.0	43.5
Ponderosa pine	4.4	7.4	11.0	22.8	21.1
Lodgepole pine	2.8	6.5	7.8	17.0	15.7
Western larch	0.9	6.0	1.2	8.2	7.6
Subalpine fir-spruce	0.4	6.2	0.1	6.8	6.3
Spruce	0.2	2.0	1.7	4.0	3.7
Western redcedar	*	0.2	0.5	0.7	0.6
Whitebark pine	*	-	0.6	0.6	0.5
Grand fir	-	-	-	-	-
Juniper	-	-	-	-	-
Total softwoods	21.3	53.2	32.5	107.0	99.0
Cottonwood	*	0.5	0.5	1.1	1.0
Aspen	0.1	-	-	0.1	**
Total hardwoods	0.1	0.5	0.5	1.1	1.0
All forest types	21.4	53.7	33.0	108.1	100.0

Table 46. Area of commercial timberland by forest type and ownership group, Missoula County, Working Circle 2, (thousand acres).

Forest Type	Ownership Group			Total	Percentage of Total
	State and Other Public	Forest Industry	Other Private		
	-----thousand acres-----				
Douglas-fir	39.8	193.4	42.8	276.0	43.2
Ponderosa pine	18.9	54.7	54.5	128.1	20.0
Lodgepole pine	12.3	54.0	33.1	99.3	15.5
Western larch	3.8	43.1	5.1	51.9	8.1
Subalpine fir-spruce	1.3	42.9	1.0	45.2	7.1
Spruce	1.7	14.5	6.5	22.7	3.6
Western redcedar	0.2	2.5	2.1	4.9	0.8
Whitebark pine	0.3	-	2.0	2.3	0.4
Grand fir	-	-	-	-	-
Juniper	-	-	-	-	-
Total softwoods	78.2	405.0	147.1	630.4	98.7
Cottonwood	0.7	2.7	4.3	7.7	1.2
Aspen	0.4	-	-	0.4	0.1
Total hardwoods	1.1	2.7	4.3	8.1	1.3
All forest types	79.4	407.7	151.4	638.5	100.0

\*Indicates less than 50 acres.

\*\*Indicates less than 0.5 percent.

Table 47. Area of commercial timberland by forest type and ownership group, Ravalli County, Working Circle 2, (thousand acres).

Forest Type	Ownership Group			Total	Percentage of Total
	State and Other Public	Forest Industry	Other Private		
	-----thousand acres-----				
Douglas-fir	14.9	11.4	50.6	76.9	56.2
Ponderosa pine	5.6	3.1	28.2	36.9	27.0
Lodgepole pine	2.3	-	1.0	3.3	2.4
Western larch	1.1	1.2	3.8	6.0	4.4
Subalpine fir-spruce	0.5	0.8	1.8	3.1	2.3
Spruce	0.4	-	1.0	1.4	1.0
Western redcedar	-	-	-	-	-
Whitebark pine	-	-	-	-	-
Grand fir	0.2	0.2	2.1	2.5	1.8
Juniper	*	0.1	0.6	0.7	0.5
Total softwoods	25.2	16.8	89.0	130.9	95.6
Cottonwood	0.1	-	5.0	5.1	3.7
Aspen	0.2	0.1	0.6	0.9	0.7
Total hardwoods	0.3	0.1	5.6	6.0	4.4
All forest types	25.5	16.9	94.6	136.9	100.0

Table 48. Net volume of growing stock on commercial timberland by forest type and ownership group, Mineral County, Working Circle 2, (thousand cubic feet).

Forest Type	Ownership Group			Total	Percentage of Total
	State and Other Public	Forest Industry	Other Private		
	-----thousand cubic feet-----				
Douglas-fir	18,993	33,188	13,658	65,839	35.2
Ponderosa pine	6,627	7,799	14,969	29,395	15.7
Lodgepole pine	8,164	16,234	17,478	41,877	22.4
Western larch	1,867	8,396	2,809	13,072	7.0
Subalpine fir-spruce	636	16,805	-	17,441	9.3
Spruce	689	7,405	5,630	13,725	7.3
Western redcedar	56	774	1,522	2,352	1.3
Whitebark pine	10	-	1,590	1,600	0.8
Grand fir	-	-	-	-	-
Juniper	-	-	-	-	-
Softwood types	37,042	90,602	57,657	185,300	99.0
Cottonwood	4	1,776	40	1,819	1.0
Aspen	35	-	-	35	**
Hardwood types	39	1,776	40	1,855	1.0
All forest types	37,081	92,378	57,696	187,155	100.0

\*Indicates less than 50 acres.

\*\*Indicates less than 0.05 percent.

Table 49. Net volume of growing stock on commercial timberland by forest type and ownership group, Missoula County, Working Circle 2, (thousand cubic feet).

Forest Type	Ownership Group			Total	Percentage of Total
	State and Other Public	Forest Industry	Other Private		
	-----thousand cubic feet-----				
Douglas-fir	61,550	243,519	59,864	364,933	35.6
Ponderosa pine	26,973	55,369	70,641	152,984	14.9
Lodgepole pine	30,930	133,896	68,154	232,981	22.7
Western larch	7,627	50,510	10,772	68,909	6.7
Subalpine fir-spruce	1,417	101,543	-	102,960	10.1
Spruce	5,477	42,070	20,205	67,752	6.6
Western redcedar	675	9,351	6,426	16,451	1.6
Whitebark pine	824	-	5,154	5,978	0.6
Grand fir	-	-	-	-	-
Juniper	-	-	-	-	-
Softwood types	135,473	636,258	241,217	1,012,949	98.8
Cottonwood	597	8,744	2,814	12,155	1.2
Aspen	215	-	-	215	*
Hardwood types	812	8,744	2,814	12,370	1.2
All forest types	136,285	645,003	244,031	1,025,319	100.0

Table 50. Net volume of growing stock on commercial timberland by forest type and ownership group, Ravalli County, Working Circle 2, (thousand cubic feet).

Forest Type	Ownership Group			Total	Percentage of Total
	State and Other Public	Forest Industry	Other Private		
	-----thousand cubic feet-----				
Douglas-fir	22,339	17,545	63,211	103,095	54.6
Ponderosa pine	7,917	6,101	42,384	56,402	29.8
Lodgepole pine	6,487	-	871	7,358	3.9
Western larch	2,051	1,568	4,497	8,116	4.3
Subalpine fir-spruce	607	838	1,974	3,418	1.8
Spruce	1,343	-	1,836	3,179	1.7
Western redcedar	-	-	-	-	-
Whitebark pine	-	-	-	-	-
Grand fir	52	49	461	562	0.3
Juniper	4	7	49	60	*
Softwood types	40,799	26,107	115,284	182,190	96.4
Cottonwood	157	-	6,380	6,537	3.5
Aspen	90	18	123	231	0.1
Hardwood types	247	18	6,502	6,768	3.6
All forest types	41,046	26,126	121,786	188,958	100.0

\*Indicates less than 0.05 percent.

Table 51. Net volume of sawtimber on commercial timberland by forest type and ownership group, Mineral County, Working Circle 2, (thousand board feet Scribner).

Forest Type	Ownership Group			Total	Percentage of Total
	State and Other Public	Forest Industry	Other Private		
	-----thousand board feet-----				
Douglas-fir	62,821	104,657	36,952	204,431	36.1
Ponderosa pine	25,917	26,982	50,659	103,558	18.3
Lodgepole pine	20,299	22,071	30,453	72,823	12.9
Western larch	6,534	33,634	8,843	49,011	8.7
Subalpine fir-spruce	733	64,510	-	65,243	11.5
Spruce	1,625	33,017	17,952	52,594	9.3
Western redcedar	120	3,291	3,256	6,667	1.2
Whitebark pine	30	-	4,532	4,562	0.8
Grand fir	-	-	-	-	-
Juniper	-	-	-	-	-
Softwood types	118,079	288,163	152,647	558,889	98.8
Cottonwood	13	6,767	126	6,906	1.2
Aspen	57	-	-	57	*
Hardwood types	70	6,767	126	6,963	1.2
All forest types	118,149	294,930	152,773	565,853	100.0

Table 52. Net volume of sawtimber on commercial timberland by forest type and ownership group, Missoula County, Working Circle 2, (thousand board feet Scribner).

Forest Type	Ownership Group			Total	Percentage of Total
	State and Other Public	Forest Industry	Other Private		
	-----thousand board feet-----				
Douglas-fir	201,496	756,653	169,505	1,127,653	37.0
Ponderosa pine	101,929	190,888	244,276	537,093	17.6
Lodgepole pine	72,765	159,831	127,534	360,130	11.8
Western larch	25,704	194,865	35,205	255,774	8.4
Subalpine fir-spruce	1,645	383,399	-	385,044	12.7
Spruce	15,351	181,418	64,660	261,429	8.6
Western redcedar	1,443	39,753	13,747	54,944	1.8
Whitebark pine	2,349	-	14,693	17,042	0.6
Grand fir	-	-	-	-	-
Juniper	-	-	-	-	-
Softwood types	422,682	1,906,807	669,619	2,999,108	98.5
Cottonwood	2,405	33,363	11,264	47,032	1.5
Aspen	352	-	-	352	*
Hardwood types	2,756	33,363	11,264	47,383	1.5
All forest types	425,438	1,940,170	680,884	3,046,492	100.0

\* Indicates less than 0.05 percent.



Table 53. Net volume of sawtimber on commercial timberland by forest type and ownership group, Ravalli County, Working Circle 2, (thousand board feet Scribner).

Forest Type	Ownership Group			Total	Percentage of Total
	State and Other Public	Forest Industry	Other Private		
	-----thousand board feet-----				
Douglas-fir	76,539	58,586	209,198	344,323	52.5
Ponderosa pine	31,566	23,051	165,211	219,828	33.6
Lodgepole pine	16,199	-	3,615	19,814	3.0
Western larch	7,275	6,001	15,528	28,804	4.4
Subalpine fir-spruce	710	1,002	2,361	4,073	0.6
Spruce	3,133	-	7,295	10,428	1.6
Western redcedar	-	-	-	-	-
Whitebark pine	-	-	-	-	-
Grand fir	61	57	538	656	0.1
Juniper	16	30	202	248	-
Softwood types	135,499	88,726	403,949	628,175	95.8
Cottonwood	638	-	25,920	26,558	4.1
Aspen	171	76	504	751	0.1
Hardwood types	809	76	26,424	27,309	4.2
All forest types	136,308	88,803	430,373	655,484	100.0

#### Volume by Species and Ownership Group

Tables 54 through 59 give the volume of growing stock and sawtimber by species, ownership group, and county. As would be expected, Douglas-fir had the most volume. Again ponderosa pine had the second most board foot volume in each county, but lodgepole pine had the second most cubic foot volume in Mineral and Missoula Counties. On forest industry land in Mineral and Missoula Counties, western larch had the second most board foot volume.

Figure 18. Net volume of growing stock by county, Working Circle 2.

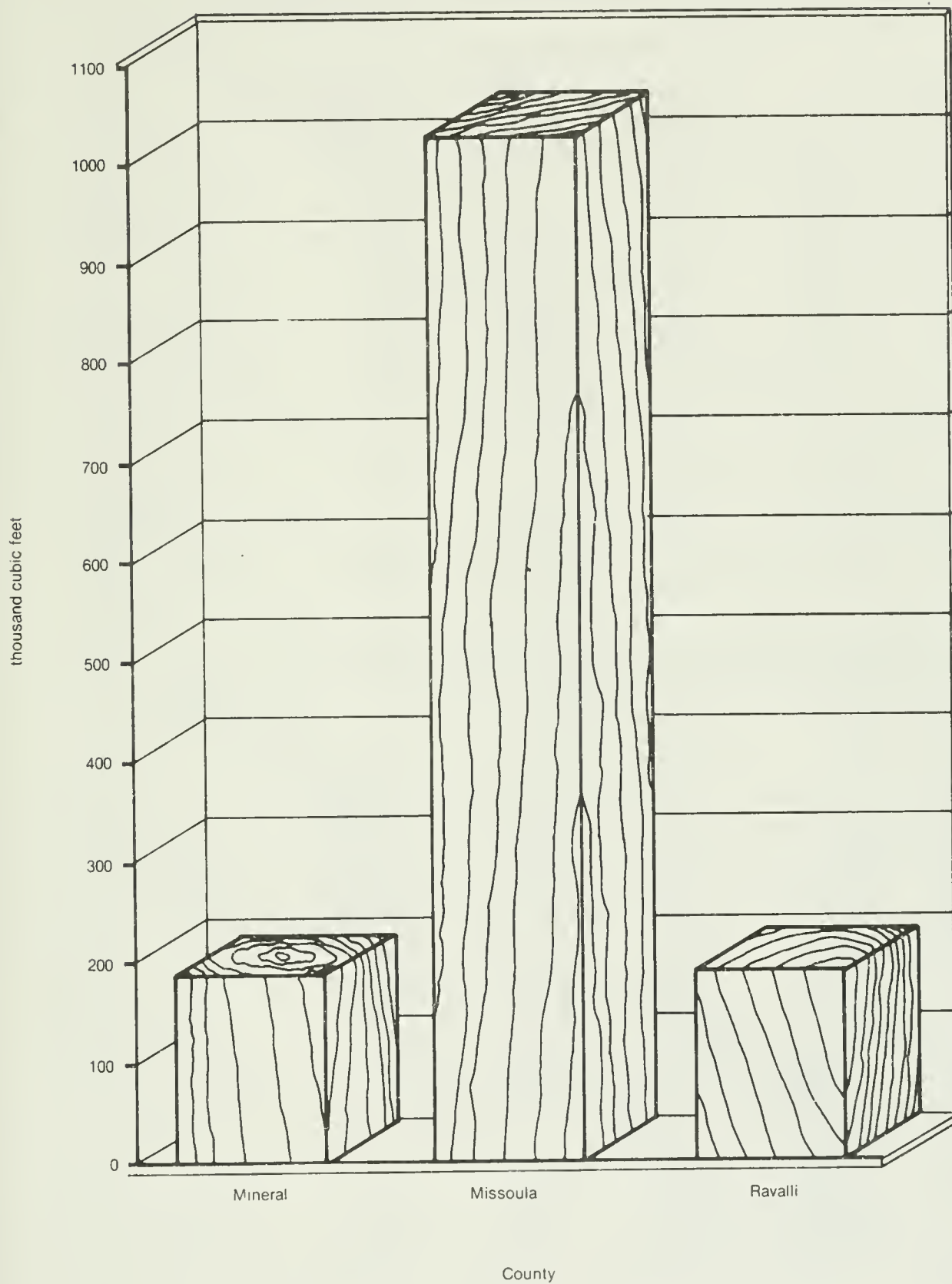


Figure 19. Net volume of sawtimber by county, Working Circle 2.

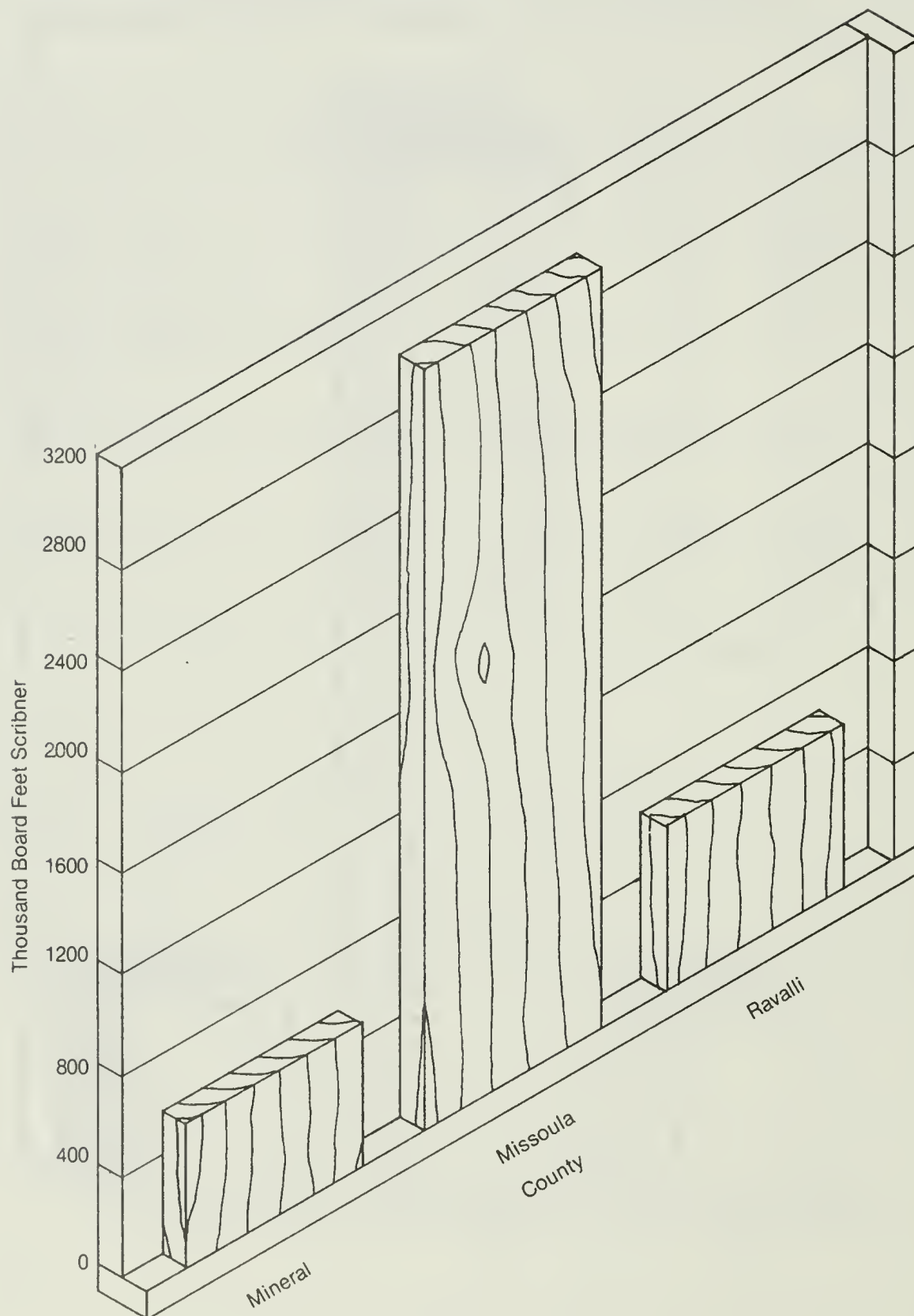


Table 54. Net volume of growing stock on commercial timberland by species and ownership group, Mineral County, Working Circle 2, (thousand cubic feet).

Species	Ownership Group			Total	Percentage of Total
	State and Other Public	Forest Industry	Other Private		
	-----thousand cubic feet-----				
Douglas-fir	15,137	29,218	12,883	57,237	30.6
Ponderosa pine	8,757	10,702	14,980	34,438	18.4
Lodgepole pine	7,685	19,453	15,525	42,663	22.8
Western larch	3,794	13,158	5,111	22,062	11.8
Subalpine fir	928	5,685	1,271	7,884	4.2
Spruce	497	11,599	4,498	16,595	8.9
Western redcedar	13	660	361	1,034	0.6
Whitebark pine	123	-	1,041	1,164	0.6
Grand fir	70	515	441	1,025	0.5
Western white pine	2	114	62	178	0.1
Softwood species	<u>37,007</u>	<u>91,103</u>	<u>56,172</u>	<u>184,282</u>	<u>98.5</u>
Cottonwood	7	902	153	1,062	0.5
Aspen	68	2	1,371	1,441	0.8
Other hardwoods	-	370	-	-	0.2
Hardwood species	<u>75</u>	<u>1,275</u>	<u>1,524</u>	<u>2,873</u>	<u>1.5</u>
Total all species	<u>37,081</u>	<u>92,378</u>	<u>57,696</u>	<u>187,155</u>	<u>100.0</u>

Table 55. Net volume of growing stock on commercial timberland by species and ownership group, Missoula County, Working Circle 2, (thousand cubic feet).

Species	Ownership Group			Total	Percentage of Total
	State and Other Public	Forest Industry	Other Private		
	-----thousand cubic feet-----				
Douglas-fir	50,111	204,892	58,059	313,062	30.5
Ponderosa pine	32,841	75,096	69,334	177,272	17.3
Lodgepole pine	29,285	152,493	60,878	242,655	23.7
Western larch	13,635	90,240	20,032	123,907	12.1
Subalpine fir	3,336	36,808	4,386	44,530	4.3
Spruce	4,128	69,229	16,711	90,068	8.8
Western redcedar	160	5,063	1,522	6,746	0.7
Whitebark pine	816	-	3,375	4,191	0.4
Grand fir	317	3,619	1,895	5,831	0.6
Western white pine	27	992	261	1,280	0.1
Softwood species	<u>134,655</u>	<u>638,431</u>	<u>236,455</u>	<u>1,009,542</u>	<u>98.5</u>
Cottonwood	612	4,765	3,003	8,380	0.8
Aspen	1,018	15	4,573	5,606	0.5
Other hardwoods	-	1,791	-	1,791	0.2
Hardwood species	<u>1,630</u>	<u>6,571</u>	<u>7,576</u>	<u>15,777</u>	<u>1.5</u>
Total all species	<u>136,285</u>	<u>645,003</u>	<u>244,031</u>	<u>1,025,319</u>	<u>100.0</u>

Table 56. Net volume of growing stock on commercial timberland by species and ownership group, Ravalli County, Working Circle 2 (thousand cubic feet).

Species	Ownership Group			Total	Percentage of Total
	State and Other Public	Forest Industry	Other Private		
	-----thousand cubic feet-----				
Douglas-fir	17,663	14,984	54,466	87,113	46.1
Ponderosa pine	10,826	7,140	47,806	65,773	34.8
Lodgepole pine	6,679	1,374	4,173	12,226	6.5
Western larch	3,429	874	2,583	6,887	3.6
Subalpine fir	1,038	892	2,345	4,275	2.3
Spruce	977	478	3,123	4,577	2.4
Western redcedar	-	-	-	-	-
Whitebark pine	86	-	-	86	*
Grand fir	86	274	732	1,093	0.6
Western white pine	-	-	-	-	-
Softwood species	40,784	26,016	115,229	182,029	96.3
Cottonwood	150	51	6,109	6,310	3.4
Aspen	113	58	448	619	0.3
Other hardwoods	-	-	-	-	-
Hardwood species	263	109	6,557	6,929	3.7
Total all species	41,046	26,126	121,786	188,958	100.0

Table 57. Net volume of sawtimber on commercial timberland by species and ownership group, Mineral County, Working Circle 2, (thousand board feet Scribner).

Species	Ownership Group			Total	Percentage of Total
	State and Other Public	Forest Industry	Other Private		
	-----thousand board feet-----				
Douglas-fir	48,472	92,539	33,371	174,383	30.8
Ponderosa pine	36,031	41,660	51,499	129,190	22.8
Lodgepole pine	13,702	28,412	28,642	70,756	12.5
Western larch	16,765	57,216	14,888	88,868	15.7
Subalpine fir	690	13,239	1,734	15,663	2.8
Spruce	1,508	52,355	13,914	67,778	12.0
Western redcedar	43	2,497	1,172	3,712	0.7
Whitebark pine	482	-	2,942	3,424	0.6
Grand fir	251	1,788	763	2,802	0.5
Western white pine	10	533	276	819	0.1
Softwood species	117,955	290,240	149,200	557,394	98.5
Cottonwood	14	3,775	394	4,183	0.7
Aspen	180	-	3,180	3,359	0.6
Other hardwoods	-	916	-	916	0.2
Hardwood species	194	4,691	3,574	8,458	1.5
Total all species	118,149	294,930	152,773	565,853	100.0

\*Indicates less than 0.05 percent.



Table 58. Net volume of sawtimber on commercial timberland by species and ownership group, Missoula County, Working Circle 2, (thousand board feet Scribner).

Species	Ownership Group			Total	Percentage of Total
	State and Other Public	Forest Industry	Other Private		
	-----thousand board feet-----				
Douglas-fir	157,629	636,394	158,033	952,056	31.3
Ponderosa pine	130,335	290,278	243,738	664,351	21.8
Lodgepole pine	54,397	192,024	120,243	366,664	12.0
Western larch	58,046	375,038	60,394	493,478	16.2
Subalpine fir	3,384	80,072	6,071	89,528	2.9
Spruce	13,011	306,374	51,726	371,110	12.2
Western redcedar	520	19,244	4,949	24,712	0.8
Whitebark pine	2,508	-	9,537	12,045	0.4
Grand fir	846	11,612	3,375	15,834	0.5
Western white pine	122	4,798	1,163	6,083	0.2
Softwood species	420,799	1,915,833	659,230	2,995,862	98.3
Cottonwood	2,316	19,905	11,090	33,311	1.1
Aspen	2,324	-	10,564	12,888	0.4
Other hardwoods	-	4,432	-	4,432	0.2
Hardwood species	4,640	24,337	21,653	50,630	1.7
Total all species	425,438	1,940,170	680,884	3,046,492	100.0

Table 59. Net volume of sawtimber on commercial timberland by species and ownership group, Ravalli County, Working Circle 2, (thousand board feet Scribner).

Species	Owner Group			Total	Percentage of Total
	State and Other Public	Forest Industry	Other Private		
	-----thousand board feet-----				
Douglas-fir	57,689	47,898	167,823	273,410	41.7
Ponderosa pine	45,210	27,363	192,616	265,189	40.5
Lodgepole pine	12,090	4,977	14,854	31,922	4.9
Western larch	15,508	3,512	9,933	28,952	4.4
Subalpine fir	1,373	2,620	6,743	10,735	1.6
Spruce	2,943	1,093	11,024	15,061	2.3
Western redcedar	-	-	-	-	-
Whitebark pine	316	-	-	316	0.1
Grand fir	360	1,135	3,049	4,544	0.7
Western white pine	-	-	-	-	-
Softwood species	135,488	88,599	406,043	630,129	96.2
Cottonwood	592	204	24,331	25,127	3.8
Aspen	228	-	-	228	*
Other hardwoods	-	-	-	-	-
Hardwood species	820	204	24,331	25,355	3.8
Total all species	136,308	88,803	430,373	655,484	100.0

\*Indicates less than 0.05 percent.

## Growth and Mortality

Missoula County had the most sampled commercial timberland in each ownership group, so it follows that it would also have the most growth and mortality (see tables 60 through 63). Tables 64 and 65 give growth and mortality per acre, making it easier to compare different sized counties. Ravalli County had the most growth and least mortality per acre in the working circle. Missoula County had the least cubic foot growth per acre, and the same board foot mortality per acre as Mineral County.

Table 60. Net annual growth of growing stock on commercial softwood forest types by county and ownership group, Working Circle 2, (thousand cubic feet).

County	Ownership Group			
	State and Other Public	Forest Industry	Other Private	All Owners
	-----thousand cubic feet-----			
Mineral	623	1,300	1,395	3,318
Missoula	2,311	10,111	5,766	18,188
Ravalli	700	810	3,484	4,994
Total	3,634	12,220	10,645	26,500

Table 61. Net annual growth of sawtimber on commercial softwood forest types by county and ownership group, Working Circle 2, (thousand board feet Scribner).

County	Ownership Group			
	State and Other Public	Forest Industry	Other Private	All Owners
	-----thousand board feet-----			
Mineral	2,006	4,405	4,827	11,238
Missoula	7,733	31,251	20,669	59,653
Ravalli	2,408	2,478	12,895	17,781
Total	12,147	38,134	38,390	88,672

Table 62. Net annual mortality of growing stock on commercial softwood forest types by county and ownership group, Working Circle 2, (thousand cubic feet).

County	Ownership Group			
	State and Other Public	Forest Industry	Other Private	All Owners
	-----thousand cubic feet-----			
Mineral	267	759	398	1,424
Missoula	1,080	5,346	1,628	8,055
Ravalli	296	96	308	701
Total	1,644	6,202	2,334	10,180

Table 63. Net annual mortality of sawtimber on commercial softwood forest types by county and ownership group, Working Circle 2, (thousand board feet Scribner).

County	Ownership Group			
	State and Other Public	Forest Industry	Other Private	All Owners
	-----thousand board feet-----			
Mineral	502	2,185	1,113	3,799
Missoula	2,319	15,412	4,627	22,357
Ravalli	574	217	707	1,499
Total	3395	17,814	6,446	27,655

Table 64. Net annual growth per acre on commercial softwood timberland by county, Working Circle 2, (cubic feet/acre and board feet Scribner/acre).

County	Growing Stock Cubic feet/acre	Sawtimber Board feet/acre
Mineral	31.0	105.0
Missoula	28.9	94.6
Ravalli	38.1	135.8

Table 65. Net annual mortality per acre on commercial softwood timberland by county, Working Circle 2, (cubic feet/acre and board feet Scribner/acre).

County	Growing Stock Cubic feet/acre	Sawtimber Board feet/acre
Mineral	13.3	35.5
Missoula	12.8	35.5
Ravalli	5.4	11.4

## Silvicultural Treatment Opportunities

Mineral County The two leading treatment opportunities in Mineral County were harvest--high risk with 24,900 acres and harvest--low risk with 15,200 acres. Some of the other leading treatment opportunities shown in table 67 are: no treatment due to productive condition (14,500) acres, regeneration of understocked areas (8,500 acres), precommercial thinning (8,400) acres, and sanitation (4,000 acres).

If harvest--high risk is ignored, about 44 percent of the commercial softwood timberland was classified into categories which imply that various silvicultural treatments are available. If harvest--high risk is added in, the total area of softwood timberland with available treatment opportunities was 72,300 acres, or 68 percent.

For timberlands in the excellent and good quality classes, Mineral County had 22,600 acres listed under categories which indicate that no immediate treatment opportunities are available (codes 11, 15, 30, 32, 33 and 40). That leaves 54,400 acres of excellent and good rated timberlands that have silvicultural treatment opportunities available to improve the forest's condition and timber production (see table 68).

Timberland acreage by treatment class shows the total number of acres categorized as having a particular treatment opportunity. Acreage by treatment opportunity class makes it easier to identify which treatment class has the most acres assigned to it without having to add up acreages for all of the combination codes. The four most common treatment classes in Mineral County were: harvest--high risk (24,900 acres), precommercial thinning (15,900 acres), harvest--low risk (15,200 acres), and overstory removal (15,200 acres) (see table 69).

Table 66. Treatment opportunity code definitions for tables 67, 68, 70, 71, 73, and 74.

10	Harvest - high risk
11	Harvest - low risk
12	Commercial thinning
13	Overstory removal
14	Two storied stand (overstory: harvest - high risk, understory: manageable)
15	Two storied stand (overstory: harvest - low risk, understory: manageable)
20	Precommercial thinning
21	Stand conversion
22	Sanitation
23	Regeneration of understocked areas
30	No treatment due to productive condition
32	No treatment inoperable
33	No treatment deferred until merchantable
40	Unknown - poor crowns, good growth

#### No Overlap

12, 13	Commercial thinning, overstory removal
13, 20	Overstory removal, precommercial thinning
13, 20, 23	Overstory removal, precommercial thinning, regeneration of understocked areas
13, 21	Overstory removal, stand conversion
13, 23	Overstory removal, regeneration of understocked areas
13, 33	Overstory removal, no treatment deferred until merchantable
20, 23	Precommercial thinning, regeneration of understocked areas
22, 23	Sanitation, regeneration of understocked areas
22, 33	Sanitation, no treatment deferred until merchantable

#### Possible Overlap

12, 13, 22	Commercial thinning, overstory removal, sanitation
12, 22	Commercial thinning, sanitation
13, 20, 22	Overstory removal, precommercial thinning, sanitation
13,20,22,23	Overstory removal, precommercial thinning, sanitation, regeneration of understocked areas
13, 22	Overstory removal, sanitation
13, 22, 23	Overstory removal, sanitation, regeneration of understocked areas
13, 22, 33	Overstory removal, sanitation, no treatment deferred until merchantable
20, 22	Precommercial thinning, sanitation
20, 22, 23	Precommercial thinning, sanitation, regeneration of understocked areas



Table 67. Area of commercial softwood timberland by treatment opportunity group and MAI site class, Mineral County, Working Circle 2 (thousand acres).

Treatment Opportunity Group	Site Class (Ft <sup>3</sup> /Acre/Year)					Total
	20-49	50-84	85-119	120-164	165+	
	-----thousand acres-----					
10	3.2	15.8	5.1	0.7	-	24.9
11	3.0	7.8	3.4	1.1	-	15.2
12	-	-	-	0.2	-	0.2
13	0.5	0.9	1.3	0.4	-	3.0
14	0.6	0.9	-	-	-	1.5
15	-	0.2	-	0.6	-	0.8
20	1.4	4.6	2.4	-	-	8.4
21	-	3.1	0.4	*	-	3.4
22	0.3	2.2	1.6	-	-	4.0
23	2.9	4.6	1.0	-	-	8.5
30	2.9	6.4	3.4	1.7	-	14.5
32	-	-	-	-	-	-
33	-	0.8	0.5	-	-	1.4
40	-	2.4	1.2	-	-	3.6
12,13	-	-	0.8	-	-	0.8
13, 20	0.4	1.8	0.9	-	-	3.1
13,20,23	-	-	-	-	-	-
13,21	0.6	1.8	*	-	-	2.4
13,23	0.3	0.9	0.5	0.2	-	1.9
13,33	-	0.8	-	-	-	0.8
20,23	0.2	0.8	-	-	-	1.0
22,23	0.2	0.8	-	-	-	1.0
22,33	-	0.6	-	-	-	0.6
12,13,22	-	-	-	-	-	-
12,22	-	-	-	-	-	-
13,20,22	0.2	-	0.5	-	-	0.7
13,20,22,23	-	-	-	-	-	-
13,22	0.2	0.9	0.6	-	-	1.8
13,22,23	-	-	-	0.6	-	0.6
13,22,33	-	0.1	0.2	-	-	0.2
20,22	1.1	0.5	0.9	-	-	2.5
20,22,23	-	0.2	-	-	-	0.2
Total	18.1	58.8	24.6	5.6	-	107.0

\*Indicates less than 50 acres.

Table 68. Area of commercial softwood timberland by treatment opportunity group and timberland quality class, Mineral County, Working Circle 2, (thousand acres).

Treatment Opportunity Group	Timberland Quality Class				
	Excellent	Good	Fair	Poor	Total
	-----thousand acres-----				
10	5.1	10.4	5.8	3.6	24.9
11	3.8	4.9	4.7	1.8	15.2
12	0.2	-	-	-	0.2
13	1.6	0.6	0.8	-	3.0
14	-	0.7	0.6	0.2	1.5
15	0.6	-	0.2	-	0.8
20	1.8	3.1	3.0	0.5	8.4
21	*	1.8	1.6	-	3.4
22	1.6	1.7	0.5	0.3	4.0
23	0.4	2.9	3.1	2.1	8.5
30	3.6	4.8	4.1	2.0	14.5
32	-	-	-	-	-
33	0.5	0.8	-	-	1.4
40	1.2	1.3	1.1	-	3.6
12, 13	0.8	-	-	-	0.8
13, 20	0.9	1.3	0.6	0.3	3.1
13, 20, 23	-	-	-	-	-
13, 21	*	1.4	1.0	-	2.4
13, 23	0.7	0.3	0.3	0.6	1.9
13, 33	-	0.8	-	-	0.8
20, 23	-	0.8	0.2	-	1.0
22, 23	-	0.8	0.2	-	1.0
22, 33	-	0.6	-	-	0.6
12, 13, 22	-	-	-	-	-
12, 22	-	-	-	-	-
13, 20, 22	0.5	-	0.2	-	0.7
13, 20, 22, 23	-	-	-	-	-
13, 22	0.6	0.4	0.4	0.3	1.8
13, 22, 23	-	-	-	0.6	0.6
13, 22, 33	0.2	0.1	-	-	0.2
20, 22	0.6	0.5	1.4	-	2.5
20, 22, 23	-	-	-	0.2	0.2
Total	24.9	40.0	29.7	12.4	107.0

\*Indicates less than 50 acres.

Table 69. Area of commercial softwood timberland by treatment class and timberland quality class, Mineral County, Working Circle 2, thousand acres).

Treatment Class	Timberland Quality Class				
	Excellent	Good	Fair	Poor	Total
	-----thousand acres-----				
Harvest-high risk	5.1	10.4	5.8	3.6	24.9
Harvest-low risk	3.8	4.9	4.7	1.8	15.2
Commercial thinning	1.0	-	-	-	1.0
Overstory removal	5.3	4.9	3.2	1.8	15.2
Two storied stand:	-	0.7	0.6	0.2	1.5
Overstory, harvest-high risk					
Understory, manageable					
Two storied stand:	0.6	-	0.2	-	0.8
Overstory, harvest-low risk					
Understory, manageable					
Precommercial thinning	3.9	5.8	5.4	0.9	15.9
Stand conversion	*	3.3	2.5	-	5.8
Sanitation	3.5	4.1	2.7	1.3	11.7
Regeneration of understocked areas	1.1	4.7	3.8	3.5	13.1
No treatment due to	3.6	4.8	4.1	2.0	14.5
productive condition					
No treatment-inoperable	-	-	-	-	-
No treatment-deferred	0.7	2.3	-	-	3.0
until merchantable					
Unknown-poor crowns, good growth	1.2	1.3	1.1	-	3.6

\*Indicates less than 50 acres.

Missoula County In Missoula County the two leading treatment opportunities were harvest--high risk with 143,600 acres and no treatment due to productive condition with 87,300 acres. Some of the other leading treatment opportunities shown in table 70 are: harvest--low risk (84,900 acres), precommercial thinning (55,100 acres), regeneration of understocked areas (54,100 acres), and a combination of overstory removal and precommercial thinning (24,700 acres).

If harvest--high risk is ignored, 46 percent of the commercial softwood timberland was classified into categories which imply that various silvicultural treatments are available. If harvest--high risk is added in, the total area of softwood timberland with available treatment opportunities was 433,200 acres, or 69 percent.

For timberlands in the excellent and good quality classes, Missoula County had 117,900 acres listed under categories which indicate that no immediate treatment opportunities are available (codes 11, 15, 30, 32, 33 and 40). That leaves 259,700 acres of excellent and good rated timberlands that had silvicultural treatment opportunities available to improve the forest's condition and timber production (see table 71).

Timberland acreage by treatment class shows the total number of acres categorized as having a particular treatment opportunity. Acreage by treatment opportunity class makes it easier to identify which treatment class has the most acres assigned to it without having to add up acreages for all of the combination codes. The four most common treatment classes in Missoula County were: harvest--high risk (143,600 acres), precommercial thinning (109,600 acres), overstory removal (92,100 acres), and no treatment due to productive condition (87,300 acres) (see table 72).

Table 70. Area of commercial softwood timberland by treatment opportunity group and MAI Site Class, Missoula County, Working Circle 2, (thousand acres).

Treatment Opportunity Group	Site Class (Ft <sup>3</sup> /Acre/Year)					Total
	20-49	50-84	85-119	120-164	165+	
	-----thousand acres-----					
10	19.8	90.4	30.2	3.1	-	143.6
11	15.8	45.3	19.2	4.6	-	84.9
12	-	-	-	0.9	-	0.9
13	5.1	7.8	7.3	0.8	-	20.9
14	3.2	5.3	-	-	-	8.5
15	-	0.9	-	2.3	-	3.2
20	8.8	33.1	13.3	-	-	55.1
21	-	20.9	0.8	0.6	-	22.3
22	2.4	9.7	7.3	-	-	19.5
23	19.0	30.7	4.4	-	-	54.1
30	15.4	45.0	17.4	9.4	-	87.3
32	-	-	-	-	-	-
33	-	4.8	2.4	-	-	7.2
40	-	12.7	3.4	-	-	16.1
12, 13	-	-	3.2	-	-	3.2
13, 20	5.1	15.4	4.2	-	-	24.7
13, 20, 23	-	-	-	-	-	-
13, 21	1.3	7.8	0.6	-	-	9.7
13, 23	2.5	3.8	2.5	2.6	-	11.4
13, 33	-	3.2	-	-	-	3.2
20, 23	2.6	4.9	-	-	-	7.4
22, 23	2.5	4.1	-	-	-	6.7
22, 33	-	2.3	-	-	-	2.3
12, 13, 22	-	-	-	-	-	-
12, 22	-	-	-	-	-	-
13, 20, 22	2.6	-	2.4	-	-	4.9
13, 20, 22, 23	-	-	-	-	-	-
13, 22	0.7	6.7	4.1	-	-	11.6
13, 22, 23	-	-	-	1.5	-	1.5
13, 22, 33	-	0.4	0.7	-	-	1.1
20, 22	8.7	3.3	4.7	-	-	16.7
20, 22, 23	-	0.7	-	-	-	0.7
Total	115.5	359.4	128.1	25.6	-	628.6



Table 71. Area of commercial softwood timberland by treatment opportunity group and timberland quality class, Missoula County, Working Circle 2, (thousand acres).

Treatment Opportunity Group	Timberland Quality Class				Total
	Excellent	Good	Fair	Poor	
	-----thousand acres-----				
10	28.6	59.4	35.2	20.4	143.6
11	19.0	28.0	26.0	11.8	84.9
12	0.9	-	-	-	0.9
13	8.0	5.4	7.5	-	20.9
14	-	2.8	3.2	2.5	8.5
15	2.3	-	0.9	-	3.2
20	8.4	23.4	21.1	2.3	55.1
21	0.6	14.0	7.7	-	22.3
22	7.7	8.0	3.3	2.5	21.4
23	3.1	20.9	22.2	7.9	54.1
30	19.9	32.2	26.6	8.6	87.3
32	-	-	-	-	-
33	2.4	4.8	-	-	7.2
40	3.4	8.2	4.6	-	16.1
12, 13	3.2	-	-	-	3.2
13, 20	4.2	12.4	5.6	2.5	24.7
13, 20, 23	-	-	-	-	-
13, 21	0.6	7.1	2.1	-	9.7
13, 23	5.1	2.5	2.5	1.3	11.4
13, 33	-	3.2	-	-	3.2
20, 23	-	4.9	2.6	-	7.4
22, 23	-	4.1	2.5	-	6.7
22, 33	-	2.3	-	-	2.3
12, 13, 22	-	-	-	-	-
12, 22	-	-	-	-	-
13, 20, 22	2.4	-	2.6	-	4.9
13, 20, 22, 23	-	-	-	-	-
13, 22	4.1	3.4	1.6	2.5	11.6
13, 22, 23	-	-	-	1.3	1.3
13, 22, 33	0.7	0.4	-	-	1.1
20, 22	2.3	3.3	11.1	-	16.7
20, 22, 23	-	-	-	0.7	0.7
Total	126.9	250.6	188.6	64.3	630.4

Table 72. Area of commercial softwood timberland by treatment class and timberland quality class, Missoula County, Working Circle 2, (thousand acres).

Treatment Class	Timberland Quality Class				
	Excellent	Good	Fair	Poor	Total
	-----thousand acres-----				
Harvest-high risk	28.6	59.4	35.2	20.4	143.6
Harvest-low risk	19.0	28.0	26.0	11.8	84.9
Commercial thinning	4.1	-	-	-	4.1
Overstory removal	28.3	34.3	21.9	7.6	92.1
Two storied stand:	-	2.8	3.2	2.5	8.5
Overstory, harvest-high risk					
Understory, manageable					
Two storied stand:	2.3	-	0.9	-	3.2
Overstory, harvest-low risk					
Understory, manageable					
Precommercial thinning	17.2	44.0	42.9	5.5	109.6
Stand conversion	1.2	21.1	9.7	-	32.0
Sanitation	17.3	21.5	21.0	7.0	66.8
Regeneration of understock areas	8.2	32.4	29.8	11.3	81.6
No treatment due to productive condition	19.9	32.2	26.6	8.6	87.3
No treatment-inoperable	-	-	-	-	-
No treatment-deferred until merchantable	3.1	10.8	-	-	13.9
Unknown-poor crowns, good growth	3.4	8.2	4.6	-	16.1

Ravalli County The two leading treatment opportunities in Ravalli County were harvest--high risk with 26,700 acres and no treatment due to productive condition with 14,500 acres. Some of the other leading treatment opportunities shown in table 73 are sanitation (13,800 acres), regeneration of understocked areas (13,100 acres), harvest--low risk (12,800 acres), and overstory removal (10,400 acres).

If harvest--high risk is ignored, 58 percent of the commercial softwood timberland was classified into categories which imply that various silvicultural treatments are available. If harvest--high risk is added in, the total area of softwood timberland with available treatment opportunities was 102,600 acres, or 78 percent.

For timberlands in the excellent and good quality classes, Ravalli County had 17,600 acres listed under categories which indicate that no immediate treatment opportunities are available (codes 11, 15, 30, 32, 33, and 40). That leaves 101,900 acres of excellent and good rated timberlands that had silvicultural treatment opportunities available to improve the forest's condition and timber production (see table 74).

Timberland acreage by treatment class shows the total number of acres categorized as having a particular treatment opportunity. Acreage by treatment opportunity class makes it easier to identify which treatment class has the most acres assigned to it without having to add up acreages for all of the combination codes. The four most common treatment classes in Ravalli County were: harvest--high risk (26,700 acres), regeneration of understocked areas (25,600 acres), overstory removal (24,300 acres), and precommercial thinning (21,000 acres) (see table 75).

Table 73. Area of commercial softwood timberland by treatment opportunity group and MAI site class, Ravalli County, Working Circle 2, (thousand acres).

Treatment Opportunity Group	Site Class (Ft <sup>3</sup> /Acre/Year)					Total
	20-49	50-84	85-119	120-164	165+	
	-----thousand acres-----					
10	1.0	17.2	8.3	0.2	-	26.7
11	0.6	10.0	2.2	-	-	12.8
12	-	-	-	0.2	-	0.2
13	-	5.0	-	5.5	-	10.4
14	0.2	0.2	-	-	-	0.4
15	-	0.2	-	-	-	0.2
20	2.8	2.6	1.2	-	-	6.5
21	-	4.6	2.7	1.0	-	8.2
22	-	10.8	3.0	-	-	13.8
23	1.5	8.4	2.4	0.7	-	13.1
30	0.2	7.9	4.0	2.4	-	14.5
32	-	-	-	-	-	-
33	-	-	-	-	-	-
40	-	0.2	0.7	-	-	1.0
12, 13	-	-	0.2	-	-	0.2
13, 20	1.9	2.7	0.5	-	-	5.1
13, 20, 23	-	0.7	-	-	-	0.7
13, 21	0.4	0.2	1.0	-	-	1.6
13, 23	-	0.4	2.5	-	-	2.9
13, 33	0.7	0.2	-	-	-	1.0
20, 23	-	2.7	2.5	-	-	5.2
22, 23	-	0.5	-	-	-	0.5
22, 33	-	-	-	-	-	-
12, 13, 22	-	-	-	-	-	-
12, 22	-	-	-	-	-	-
13, 20, 22	-	-	-	-	-	-
13, 20, 22, 23	-	-	-	-	-	-
13, 22	0.4	0.5	0.6	-	-	1.5
13, 22, 23	-	-	-	0.4	-	0.4
13, 22, 33	-	0.1	0.4	-	-	0.5
20, 22	0.4	0.2	-	-	-	0.6
20, 22, 23	-	2.9	-	-	-	-
Total	10.1	78.1	32.2	10.5	-	130.9

Table 74. Area of commercial softwood timberland by treatment opportunity group and timberland quality class, Ravalli County, Working Circle 2, (thousand acres).

		Timberland Quality Class				
Treatment	Opportunity Group	Excellent	Good	Fair	Poor	Total
-----thousand acres-----						
10		8.5	11.5	1.2	5.4	26.7
11		2.2	1.5	4.1	5.0	12.8
12		0.2	-	-	-	0.2
13		5.5	5.0	-	-	10.4
14		-	0.2	0.2	-	0.4
15		-	-	0.2	-	0.2
20		1.2	2.6	2.8	-	6.5
21		3.4	4.6	0.2	-	8.2
22		3.0	7.9	2.9	-	13.8
23		2.8	7.6	1.9	0.7	13.1
30		4.5	7.7	2.1	0.2	14.5
32		-	-	-	-	-
33		-	-	-	-	-
40		0.7	0.2	-	-	1.0
12, 13		0.2	-	-	-	0.2
13, 20		0.5	2.5	2.1	-	5.1
23	-	0.7	-	-	0.7	13, 20,
13, 21		1.0	-	0.6	-	1.6
13, 23		2.5	-	-	0.4	2.9
13, 33		-	0.2	0.7	-	1.0
20, 23		2.5	2.7	-	-	5.2
22, 23		-	0.5	-	-	0.5
22, 33		-	-	-	-	-
12, 13, 22		-	-	-	-	-
12, 22		-	-	-	-	-
13, 20, 22		-	-	-	-	-
13, 20, 22, 23		-	-	-	-	-
13, 22		0.6	0.2	0.6	-	1.5
13, 22, 23		-	-	-	0.4	0.4
13, 22, 33		0.4	0.1	-	-	0.5
20, 22		-	0.2	0.4	-	0.6
20, 22, 23		-	2.5	-	0.4	2.9
Total		39.8	58.4	20.2	12.5	130.9



Table 75. Area of commercial softwood timberland by treatment class and timberland quality class, Ravalli County, Working Circle 2, (thousand acres).

Treatment Class	Timberland Quality Class				Total
	Excellent	Good	Fair	Poor	
	-----thousand acres-----				
Harvest-high risk	8.5	11.5	1.2	5.4	26.7
Harvest-low risk	2.2	1.5	4.1	5.0	12.8
Commercial thinning	0.5	-	-	-	0.5
Overstory removal	10.7	8.8	4.0	0.7	24.3
Two storied stand:	-	0.2	0.2	-	0.4
Overstory, harvest-high risk					
Understory, manageable					
Two storied stand:	-	-	0.2	-	0.2
Overstory, harvest-low risk					
Understory, manageable					
Precommercial thinning	4.1	11.2	5.2	0.4	21.0
Stand conversion	4.4	4.6	0.8	-	9.9
Sanitation	4.0	11.5	4.0	0.7	20.1
Regeneration of understocked areas	7.8	14.1	1.9	1.8	25.6
No treatment due to productive condition	4.5	7.7	2.1	0.2	14.5
No treatment-inoperable	-	-	-	-	-
No treatment-deferred until merchantable	0.4	0.4	0.7	-	1.5
Unknown-poor crowns, good growth	0.7	0.2	-	-	1.0

#### Grazable Forestland Data

More than two-thirds of the grazable forestland sampled in Ravalli County was in excellent or good condition. In Mineral and Missoula Counties, the figure was 86 percent. All three counties had the opportunity to substantially increase carrying capacity by improving range condition.

Table 76 gives the area of sampled commercial timberland by range condition class. The information is given by county and crown density to show where the range condition is better and where problems lie. Just over two-thirds of the grazable forestland in Ravalli County was in excellent or good condition. Mineral and Missoula Counties only had 14 percent of their grazable forestland in the fair and poor condition classes, while 86 percent was in excellent or good classes. The problem appears to exist mostly in the 0-30 percent crown density class.

Table 76. Area of commercial timberland by condition class, crown density, and county, Working Circle 2, (thousand acres).

Condition Class	Crown Density				Total
	0-30	31-50	51-70	71+*	
Mineral County	-----thousand acres-----				
Excellent	5.9	10.8	18.6	-	35.3
Good	13.1	11.4	13.1	-	37.5
Fair	3.8	3.3	3.6	-	10.7
Poor	0.6	-	0.6	-	1.2
	-	-	-	23.5	23.5
Total	23.4	25.5	35.9	23.5	108.2
Missoula County					
Excellent	38.9	60.0	106.6	-	205.4
Good	87.3	74.5	69.7	-	231.5
Fair	24.9	20.3	17.4	-	62.5
Poor	3.7	-	2.8	-	6.4
	-	-	-	132.5	132.5
Total	154.8	154.8	196.5	132.5	638.4
Ravalli County					
Excellent	4.4	8.6	20.6	-	33.6
Good	13.0	19.4	15.1	-	47.5
Fair	11.8	8.3	9.5	-	29.6
Poor	4.4	-	2.9	-	7.2
	-	-	-	19.0	19.0
Total	33.6	36.3	48.1	19.0	136.9
Working Circle Total					
Excellent	49.1	79.4	145.8	-	274.3
Good	113.3	105.4	97.8	-	316.5
Fair	40.6	31.9	30.4	-	102.8
Poor	8.6	-	6.2	-	14.8
	-	-	-	175.0	175.0
Total	211.6	216.7	280.3	175.0	883.4

\*No range data was collected on forest land with greater than 70% crown density because the range is considered to have no value for livestock.

Table 77. Available animal unit months (AUM's) on commercial timberland by condition class and crown density by county, Working Circle 2.

Condition Class	Crown Density				Total
	0-30	31-50	51-70	71+*	
Mineral County	-----AUM's-----				
Excellent	1,405	1,779	1,865	-	5,049
Good	1,649	1,245	858	-	3,751
Fair	514	390	129	-	1,032
Poor	89	-	94	-	183
Total	3,656	3,414	2,945	-	10,015
Missoula County					
Excellent	10,069	9,193	10,361	-	29,622
Good	13,164	7,829	4,454	-	25,446
Fair	3,564	2,365	832	-	6,760
Poor	559	-	426	-	984
Total	27,356	19,387	16,073	-	62,816
Ravalli County					
Excellent	539	1,309	1,428	-	3,275
Good	2,917	2,599	1,083	-	6,599
Fair	1,637	751	872	-	3,259
Poor	544	-	106	-	650
Total	5,637	4,659	3,488	-	13,783
Working Circle Total					
Excellent	12,012	12,281	13,653	-	37,946
Good	17,729	11,673	6,394	-	35,796
Fair	5,714	3,506	1,832	-	11,052
Poor	1,192	-	626	-	1,817
Total	36,647	24,460	20,673	-	86,611

\*No range data was collected on forest land with greater than 70% crown density because the range is considered to have no value for livestock.

Almost three-fourths of the available animal unit months (AUM's) on sampled commercial timberland in Working Circle 2 were in Missoula County (see table 77). This is mostly due to the fact that Missoula County had almost three-fourths of the sampled commercial timberland.

Missoula County also had the potential to have the greatest carrying capacity if all of its forested rangeland was in excellent condition, with an increase of more than 22,000 AUM's, or thirty-five percent. Ravalli County's carrying capacity could be increased by a whopping fifty-seven percent if the condition improved to excellent. Mineral County had the opportunity to carry thirty-two percent more livestock on it's forested rangeland. Table 78 gives the potential AUM's for each county by crown density.

Table 78. Potential animal unit months (AUM's) on commercial timberland by crown density and county, Working Circle 2.

County	Crown Density				Total
	0-30	31-50	51-70	71+*	
	-----AUM's-----				
Mineral	5,116	4,731	3,418	-	13,265
Missoula	38,824	27,791	18,393	-	85,008
Ravalli	9,719	7,359	4,578	-	21,656
Total	53,659	39,881	26,389	-	119,929

\*No range data was collected on forest land with greater than 70% crown density because the range is considered to have no value for livestock.

## CONCLUSIONS AND RECOMMENDATIONS

### Overview of the Current Grazable Forestland Resource

In 1978, approximately 80 percent (708,600 acres) of the sampled commercial timberland acreage had less than 71 percent crown density and, therefore, was considered grazable. The condition of the understory was estimated to be excellent or good on about 83 percent (591,000 acres) of the grazable commercial timberland. The current available carrying capacity was estimated to be 86,611 AUM's or about 72 percent of the potential available carrying capacity of 119,929 AUM's. The objective of most grazing management programs is to make optimum use of the forage resources while maintaining or improving these resources. It is clear, based on the data, that many acres are not being managed in a manner that would achieve this objective. A re-evaluation of the grazing practices on those acres experiencing a downward trend in range condition is necessary to keep the amount of acres in poor or fair condition from increasing.

The amount and location of grazable forest acreage changes from year to year as new stands are logged or burned and as crown densities in existing timber stands increase and block out the sun. In 1978, approximately 80 percent (708,600 acres) of the sampled commercial timberland acreage had less than 71 percent crown density and, therefore, was considered grazable. The condition of the forest understory was estimated to be excellent or good on about 83 percent of the grazable commercial timberland. Timberlands with crown densities of 0-30 percent showed evidence of the most overgrazing. About 23 percent of these areas were in fair or poor condition.

Overall, a total of 117,600 acres of the commercial timberland's understory were determined to be in fair or poor condition. If the ecological condition of these lands understory are not improving, their stocking rates probably need to be re-evaluated. Some of the grazable timberland that was rated as being in excellent or good condition could also be experiencing overgrazing. Over a period of time even land in excellent condition, if overgrazed, could deteriorate to a poor condition.

The current carrying capacity, defined by the inventory procedures as available animal unit months (AUM's), was estimated to be 86,611 AUM's. If every acre of grazable timberland were in excellent condition, the potential available carrying capacity would be 119,929 AUM's. The actual available carrying capacity was 72 percent of the potential available carrying capacity.



Further analysis of the data shows that 237,300 acres (33 percent) of the grazable forestland sampled had a grazability factor of 50 percent or less. In other words, the carrying capacity expressed as AUM's was reduced by one half or more on one-third of the grazable acres. This reduction was caused by physical factors on or near the site which reduced the utility of the area for grazing livestock. Some examples of these factors are percent slope, proximity to water, lack of trails and roads, and mechanical barriers.

The objective of most grazing management programs is to make optimum use of forage resources while maintaining or improving these resources. It is clear, based on the data, that many acres are not being managed in a manner that would achieve this objective.

Land managers can improve overgrazed areas by simply reducing the amount of time livestock graze an area or by reducing the amount of livestock. Land managers can also maintain or improve the grazing resource and optimize use through more aggressive management techniques that may include some or all of the following items: salting, herding (rotation grazing), fencing, increasing the number of trails, increasing water developments, and reducing slash, logging debris, and other mechanical barriers. Another obvious tactic that may conflict with timber objectives is to maintain lower crown densities or less canopy cover in those forest stands that are being grazed. This could be done by thinning precommercial material or by harvesting some commercial timber while still maintaining a crop of trees for future harvest.

## Overview of the Current Timber Resource

The average acre of state and privately owned commercial timberland in Working Circle 2 was estimated to be the second most productive in the state when compared to the averages estimated for the other working circles. In addition, 62 percent, or 540,500 acres, of the commercial softwood timberland sampled was rated as excellent or good for timber production. However, there are conditions currently existing on state and private commercial timberlands that offer opportunities to improve growth and yield.

An estimated 70 percent of the commercial timberland (605,500 acres) offered silvicultural treatment opportunities which have the potential to increase timber yields from these acres. The large amount of silvicultural treatment opportunities, the existence of many nonvigorous small to medium diameter (4.0 to 10.0 inches d.b.h.) trees of excessive age, and the large number of cull trees (24 percent of all live trees at least 1.0 inch d.b.h.) are some of the factors contributing to the modest average net growth of 31 cubic feet per acre per year. A management plan developed to improve growth and yield should be three-pronged. It would involve continued conversion of high risk sawtimber stands to younger healthier mixed species stands, intermediate treatments of submerchantable stands before the opportunity is lost, and a commitment to increase stocking in understocked areas.

The average potential growth for state and private commercial timberland in Working Circle 2 was estimated to be 73 cubic feet per acre per year. Based on unpublished inventory data, this working circle has the second highest average potential productivity in the state when compared to the averages for the other working circles.

Approximately 62 percent, or 540,500 acres, of the commercial softwood timberland was rated as good or excellent for timber production. These same acres had 2.9 billion board feet of volume or about 70 percent of the total estimated board foot inventory.

The data shows there are conditions currently existing on state and private commercial timberlands that offer opportunities to improve growth and yield. An estimated 70 percent of the commercial timberland (605,500 acres) offered silvicultural treatment opportunities which have the potential to increase timber yields from these acres. Table 110 in Appendix 3 shows there were 71.7 million cull trees (24 percent of all live trees greater than or equal to 1.0 inches d.b.h.) existing on commercial timberland. Cull trees do not provide useable growth or volume to the standing inventory. They do, however, occupy space that could be used by growing stock trees. Table 117 in Appendix 3 displays average breast height age by diameter class for various site classes and species groups. Both the average age and the range

of ages indicate there are many nonvigorous growing stock trees. These same tables also raise a concern for the genetic quality of the existing trees to produce fast growing seedlings for future crops of timber.

The large amount of silvicultural treatment opportunities, the existence of nonvigorous trees of excessive age scattered throughout the forest and the large numbers of cull trees are some of the factors which contributed to the modest average net growth of 31 cubic feet per acre per year.

Another factor contributing to the difference between measured net growth and potential net growth is the presence of 212,700 acres (24 percent of the commercial timberland) of nonstocked and seedling-sapling stands. The great majority of the trees in these stands were less than 5.0 inches at d.b.h. and contributed no volume to net growth. This is not a problem but it may be a source for predictions of increased net growth in the future. This is especially true if these stands receive more intensive timber management than existing older stands have received up to this point in time.

For this working circle, a management plan to improve growth and yield should be three-pronged. It would include continued conversion of high risk sawtimber stands to younger healthier mixed species stands, intermediate treatments of submerchantable stands before the opportunity is lost, and a commitment to increase stocking in understocked areas.

### Past Harvest Rates

Data covering a 14 year period shows timber harvesting has fluctuated but generally increased on private lands from 1970 to 1979. The average amount of timber harvested annually on private land in Working Circle 2 over 14 years was 87.5 million board feet. Missoula County supplied 80 percent of the total volume harvested from private lands during the period. State owned lands provided an average annual harvest of 2.5 million board feet.

Each year, the Forestry Division attempts to determine the amount of timber harvested on state and private lands. This amount is determined from state land records and hazard reduction agreements drawn between the state and logging operators. The volumes listed in tables 80 and 81 reflect the board foot volumes of timber loaded on trucks and delivered to mills. The smallest trees delivered are in the 6-inch diameter class. In addition to the volume brought to the mills, a portion of the merchantable volume is left in the forest as logging residue. Based on figures reported by the USDA

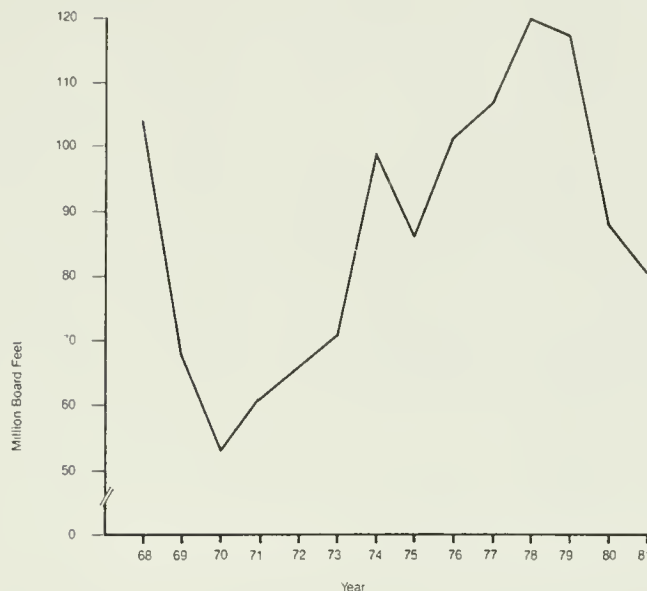
Table 79. Volume of sawtimber cut from private lands, calendar years 1968 through 1981 by county, Working Circle 2, (thousand board feet Scribner).

Year	County			Total
	Mineral	Missoula	Ravalli	
	-----thousand board feet-----			
1968	14,209	80,645	9,559	104,413
1969	13,678	49,687	4,473	67,837
1970	2,309	46,340	4,809	53,458
1971	4,472	53,043	3,696	61,211
1972	14,559	47,027	4,610	66,196
1973	15,435	50,117	5,592	71,144
1974	13,818	78,749	6,759	99,326
1975	14,795	66,771	4,037	85,604
1976	13,217	84,984	3,359	101,559
1977	12,868	83,275	10,872	107,015
1978	14,749	92,270	12,886	119,904
1979	11,025	96,735	9,653	117,414
1980	7,873	78,167	2,368	88,408
1981	10,806	976,421	84,132	80,876
Total	163,812	976,421	84,132	1,224,364
14 year average	11,701	69,744	6,009	87,455

Table 80. Volume of sawtimber cut from state lands, fiscal years 1968 through 1981 by county, Working Circle 2, (thousand board feet Scribner).

Year	County			Total
	Mineral	Missoula	Ravalli	
	-----thousand board feet-----			
1968	207	177	880	1,264
1969	27	1,708	449	2,184
1970	2,409	2,528	179	5,116
1971	19	1,058	5	1,082
1972	-	9,807	-	9,807
1973	6	188	62	256
1974	-	601	-	601
1975	25	12	21	58
1976	1	1,620	-	1,621
1977	5	3,242	97	3,344
1978	-	1,563	31	1,594
1979	523	2,604	29	3,156
1980	400	92	51	543
1981	2,934	1,726	360	5,020
Total	6,556	26,926	2,164	35,646
14 year average	468	1,923	155	2,546

Figure 20. Volume cut from private lands, calendar years 1968 through 1981, Working Circle 2, (million board feet Scribner).



Forest Service for western Montana and northern Idaho (Wilson et al. 1970), the amount of residue left on the logging site is about 7 percent of the board foot volume delivered to the mills. Timber is also harvested for railroad ties, posts, poles, rails, and firewood (cord wood) but the amount of timber harvested for these uses is small compared to the amount harvested for other forest products.

Data covering a 14-year cutting period (see table 79 and figure 20) shows that timber harvesting has fluctuated wildly but generally increased on private lands from 1970 until 1979. The currently depressed housing market, caused principally by high interest rates, has decreased harvesting rates. The average amount of timber harvested on private land in Working Circle 2 over the 14 years was 87.5 million board feet. Missoula County supplied 80 percent of the total volume of timber harvested from private lands during the period.

The amount of volume harvested from state and other public lands over the past 14 years (1968 - 1981) averaged 2.5 million board feet per year. State lands in Missoula County supplied a little over three-fourths of the volume (see table 80). The amount of timber harvested from state lands is tied closely to administrative budgets and, occasionally, the severity of the fire season.



## Current Supplies

In 1978, the estimated softwood volume on private commercial timberland was 3,510 million board feet Scribner. State and other public lands had a softwood volume of 674 million board feet. About 56 percent of the commercial timberland area had less than 5,000 net board feet per acre. Only about four percent of the softwood sawtimber volume consisted of the commercially less desirable species-- subalpine fir, grand fir and whitebark pine. The average volume of timber removed from the private land inventory since 1968 has been 93.6 million board feet Scribner annually (this figure includes logging residues). The net annual board foot growth for sawtimber on private lands was estimated to be 77.9 million board feet Scribner in 1978. Although the supply of available sawtimber is sufficient to support harvesting in excess of growth for many years to come, it can not do so indefinitely. Eventually, the net growth rate for private timberlands must increase to avoid a reduction in supply from these lands in the future.

In 1978, the estimated softwood volume of timber on forest industry-owned lands totaled 2,295 million net board feet Scribner. Other privately owned timberlands held an estimated softwood volume of 1,215 million net board feet. State and other public lands held a softwood volume of 674 million net board feet. Of the 4,186 million net board feet standing on sampled public and private lands, 2,894 million board feet (2,419 million board feet in sawtimber stands) were on commercial timberlands rated as excellent or good for timber production (see table 108, Appendix 3).

Unfortunately, 56 percent of the commercial timberland area had less than 5,000 net board feet per acre, and only 14 percent of these timberlands had 10,000 or more board feet per acre (see table 26).

Only about four percent of the softwood sawtimber volume consisted of the commercially less desirable species -- subalpine fir, grand fir and whitebark pine. Of the remaining more commercially desirable softwood species, 45 percent of the board foot volume was found on trees ranging from 9.0 inches to 15.0 inches d.b.h. (see table 107, Appendix 3).

In 1978, the amount of timber removed from the private land inventory totaled 128.3 million board feet in (this figure includes logging residues). The average volume of timber removed from the private land inventory since 1968 has been 93.6 million board feet Scribner annually (this figure also includes logging residues). The net annual board foot growth for sawtimber on private lands was estimated to be 77.9 million board feet Scribner in 1978. Subtracting net growth from harvested volume shows the standing inventory of timber was reduced by 50.4 million board feet. In other words, harvesting

in 1978 occurred at a rate that was 165 percent of sawtimber board foot growth.

The net board foot growth estimate does not include the board foot growth produced by softwood trees smaller than 9.0 inches d.b.h. or hardwood trees smaller than 11.0 inches d.b.h. Net growth in softwood trees 5.0 to 8.99 inches d.b.h. totaled 15.7 million cubic feet in 1978. Of this net growth, 12.0 million cubic feet occurred in trees in the 6-inch diameter class.

Some or all of the growth produced by poletimber size trees could be considered nullified for comparison purposes since not all of the timber or its growth is available for harvest. According to the timber availability analysis (see tables 40 and 41), 17 percent of the timber inventoried is not available for harvest due to nontimber resource uses and constraints.

The level of harvesting on private lands in 1978 was the highest recorded since 1968. But even the 14 year average harvest is higher than the net growth estimated for 1978. Although the supply of available sawtimber is sufficient to support harvesting in excess of growth for many years to come, it can not do so indefinitely. Eventually, the net growth rate for private timberlands must increase to avoid a reduction in supply from these lands in the future.

## Can Production Be Increased

A large amount of the privately owned commercial forest is still in the formative stage and can be manipulated to greatly increase future timber production. Production could also be increased through improved utilization of timber harvested.

Timber production will be a major and probably a primary use of the land for two-thirds of the commercial timberlands on state and private lands in Working Circle 2. The outlook for timber production on the remaining third owned by non-industrial private landowners is unclear. Getting the nonindustrial private forest landowner to use intensive timber management practices is difficult. It remains to be seen how well that challenge will be met.

The current rate of harvesting on private land may not be possible to continue indefinitely under the existing level of timber management. Silvicultural treatment opportunities exist that would dramatically increase the growth rates and thereby possibly eliminate potential timber supply reduction from private land. The extent to which these opportunities are realized, beginning immediately, will determine the amount of timber available for harvest in the future.

The future supply of timber from private lands will depend, to a large extent, on the intensity of forest management applied now and in the future. A large amount of the privately owned commercial forest is still in a formative stage and can be manipulated to greatly increase future timber production.

Forest managers can increase timber production in the near future by salvaging those trees that are already dead and by reducing mortality through harvesting high risk timber weakened by age, insects, and disease. Commercial thinning also could help increase production, but according to the treatment opportunities analysis conducted during this inventory, only about 5,600 acres are suitable for this treatment (see table 36). Production could be further increased through improved utilization of the timber harvested. Employing the latest harvesting and milling technologies would increase the board-foot volume recoverable per tree. These technologies include more efficient log manufacturing, smaller saw kerfs, and a more efficient first cut by the sawyer. Some mills can currently saw smaller diameter logs, which increases production because smaller trees can be economically harvested and more of each tree can be used.

Several silvicultural treatment opportunities exist to increase timber production in the distant future. According to this inventory's treatment opportunity analysis, about 70 percent (605,500 acres) of the softwood commercial timberlands in Working Circle 2 offer some type of silvicultural treatment opportunity (see table 31). Treatment opportunities besides harvesting are available on 46 percent (399,800 acres) of the softwood forest. These opportunities include combinations of the following treatments: precommercial thinning (146,500 acres), overstory removal (131,600 acres), regeneration of understocked areas (120,300 acres), and sanitation (98,600 acres) (see table 36).

A major factor that will affect future yields of timber from private forest lands will be the amount of the commercial timberland contained in relatively small land holdings. Generally, as forest lands are subdivided and decrease in size, the owners become less willing to sell their timber. Thus, as more of the forest land is developed and subdivided into smaller parcels, more and more of the timber becomes physically and economically unavailable for harvesting.

When this inventory was conducted, only nine percent of the sampled commercial timberlands were placed in the other private-individual ownership class. This ownership class is made up almost entirely of private land owners with holdings of 40 acres or less. An additional 20 percent of the timberland sampled was placed in the farmer-rancher owner class. Information and education programs could make these landowners more aware of forest management opportunities. Unfortunately, many individuals need to be contacted before much forest acreage can be treated.

Timber production will be a major and probably a primary use of the land for two-thirds of the commercial timberlands on state and private lands in Working Circle 2. The outlook for timber production on the remaining third owned by non-industrial private landowners is unclear. Getting the nonindustrial private forest landowner to use aggressive timber management practices is difficult. It remains to be seen how well that challenge will be met.

Finally, it must be reemphasized that the current rate of harvesting on private land can not continue indefinitely with existing growth rates. For that reason the question must be asked: Will net growth increase sufficiently under current forest management practices or will management have to be intensified? This question needs to be addressed in the near future. If a decline in the private land timber supply should become a reality, the economic impact could be extensive. To lessen the impact, it would be necessary to harvest more timber from federal and state timberlands.

Silvicultural treatment opportunities exist to dramatically increase the growth rates and thereby possibly eliminate any potential timber supply reduction from private land. The extent to which these opportunities are realized, beginning immediately, will determine the amount of timber available for harvest in the future.



## APPENDIX 1. DATA RELIABILITY

The sampling errors presented in tables 81 through 88 are calculated for one standard error -- the 67 percent confidence level. In other words, in two-out-of-three times, the actual value will be within the specified confidence interval. Individual cells within tables should be used with caution. Some of the data presented in other tables are based on small sample sizes and as a result have high sampling errors. For example, the percent error for individual forest type acreages within the commercial timberland total will all have a higher error than 1.1 percent (see table 81).

Table 81. Forest land area and associated sampling error percentages for Working Circle 2.

Item	Softwood Types		Hardwood Types		All Types	
	Acres	Error	Acres	Error	Acres	Error
Commercial forest land	868,306	±1.3%	15,204	±33.1%	883,510	±1.1%
Noncommercial forest land	2,290	±100.0%	1,890	±100.0%	4,180	±71.0%

Table 82. Net volume, net annual growth, and annual mortality on commercial timberland, with associated sampling error percentages for Working Circle 2.

Item	Softwood Species		Hardwood Species		All Species	
	Volume	Error	Volume	Error	Volume	Error
Volume:						
Growing stock (thousand cubic feet)	1,375,853	±4.0%	25,579	±34.2%	1,401,432	±4.0%
Sawtimber (MBF Scribner)	4,183,385	±4.9%	84,444	±36.1%	4,267,828	±4.9%
Net Growth:						
Growing stock (thousand cubic feet)	26,579	±9.0%	326	±71.2%	26,904	±8.9%
Sawtimber (MBF Scribner)	88,511	±9.1%	1,622	±95.4%	90,134	±9.1%
Mortality:						
Growing stock (thousand cubic feet)	9,935	±13.9%	277	±89.2%	10,212	±14.0%
Sawtimber (MBF Scribner)	26,595	±18.9%	1,193	±89.5%	27,788	±18.9%

Table 83. Forest land area and associated sampling error percentages for Mineral County, Working Circle 2.

Item	Softwood Types		Hardwood Types		All Types	
	Acres	Error	Acres	Error	Acres	Error
Commercial forest land	107,026	±4.5%	1,119	±100.0%	108,145	±4.3%
Noncommercial forest land	622	±100.0%	-	-	622	±100.0%

Table 84. Net volume, net annual growth, and annual mortality on commercial timberland, with associated sampling error percentages for Mineral County, Working Circle 2.

Item	Softwood Species		Hardwood Species		All Species	
	Volume	Error	Volume	Error	Volume	Error
Volume:						
Growing stock (thousand cubic feet)	184,282	±11.9%	2,873	±100.0%	187,181	±11.9%
Sawtimber (MBF Scribner)	557,394	±14.6%	8,458	±100.0%	565,853	±14.6%
Net Growth:						
Growing stock (thousand cubic feet)	3,338	±29.6%	21	±100.0%	3,359	±29.9%
Sawtimber (MBF Scribner)	11,179	±28.9%	201	±100.0%	11,380	±29.4%
Mortality:						
Growing stock (thousand cubic feet)	1,373	±42.7%	52	±100.0%	1,425	±43.2%
Sawtimber (MBF Scribner)	3,576	±57.5%	225	±100.0%	3,800	±58.3%

Table 85. Forest land area and associated sampling error percentages for Missoula County, Working Circle 2.

Item	Softwood Types		Hardwood Types		All Types	
	Acres	Error	Acres	Error	Acres	Error
Commercial forest land	630,363	±1.6%	8,109	±54.5%	638,472	±1.4%
Noncommercial forest land	1,305	±100.0%	-	-	1,305	±100.0%

Table 86. Net volume, net annual growth, and annual mortality on commercial timberland, with associated sampling error percentages for Missoula County, Working Circle 2.

Item	Softwood Species		Hardwood Species		All Species	
	Volume	Error	Volume	Error	Volume	Error
Volume:						
Growing stock (thousand cubic feet)	1,009,542	±4.7%	15,777	±46.7%	1,025,319	±4.7%
Sawtimber (MBF Scribner)	2,995,862	±5.6%	50,630	±49.9%	3,046,492	±5.6%
Net Growth:						
Growing stock (thousand cubic feet)	18,271	±11.4%	168	±100.0%	18,440	±11.4%
Sawtimber (MBF Scribner)	59,518	±11.6%	1,031	±100.0%	60,549	±11.7%
Mortality:						
Growing stock (thousand cubic feet)	7,862	±15.8%	205	±100.0%	8,067	±15.8%
Sawtimber (MBF Scribner)	21,521	±21.3%	884	±100.0%	22,405	±21.3%

Table 87. Forest land area and associated sampling error percentages for Ravalli County, Working Circle 2.

Item	Softwood Types		Hardwood Types		All Types	
	Acres	Error	Acres	Error	Acres	Error
Commercial forest land	130,917	±4.4%	5,977	±39.9%	136,894	±4.0%
Noncommercial forest land	363	±100%	1,890	±100%	2,252	±97.7%

Table 88. Net volume, net annual growth, and annual mortality on commercial timberland, with associated sampling error percentages for Ravalli County, Working Circle 2.

Item	Softwood Species Volume	Species Error	Hardwood Species Volume	Species Error	All Species Volume	Error
Volume:						
Growing stock (thousand cubic feet)	182,029	±11.6%	6,929	±44.2%	188,958	±11.4%
Sawtimber (MBF Scribner)	630,129	±14.8%	25,355	±49.0%	655,484	±14.4%
Net Growth:						
Growing stock (thousand cubic feet)	4,970	±14.2%	137	±25.9%	5,106	±13.9%
Sawtimber (MBF Scribner)	17,814	±15.7%	390	±34.5%	18,205	±15.5%
Mortality:						
Growing stock (thousand cubic feet)	701	±39.4%	20	±100.0%	721	±38.5%
Sawtimber (MBF Scribner)	1,499	±42.0%	84	±100.0%	1,583	±40.4%

## APPENDIX 2. ADDITIONAL DATA BY COUNTY

Table 89. Area of commercial timberland by M.A.I. site class for softwood and hardwood forest types by county, Working Circle 2, (thousand acres).

County and site class	Softwood Forest Types	Hardwood Forest Types	Total
Mineral County	-----thousand acres-----		
20 - 49	18.1	0.5	18.6
50 - 84	58.8	*	58.8
85 - 119	24.6	0.6	25.1
120 - 164	5.6	-	5.6
165+	-	-	-
Total	107.0	1.1	108.1
Missoula County			
20 - 49	115.5	3.1	118.6
50 - 84	361.0	1.2	362.1
85 - 119	128.5	3.8	132.3
120 - 164	25.5	-	25.5
165+	-	-	-
Total	630.5	8.1	638.5
Ravalli County			
20 - 49	10.1	1.0	11.2
50 - 84	78.1	2.1	80.2
85 - 119	32.2	2.9	35.1
120 - 164	10.5	-	10.5
165+	-	-	-
Total	130.9	6.0	136.9
Working Circle Totals			
20 - 49	143.7	4.7	148.3
50 - 84	497.9	3.2	501.2
85 - 119	185.2	7.3	192.5
120 - 164	41.5	-	41.5
165+	-	-	-
Total	868.3	15.2	883.5

Table 90. Area of commercial softwood timberland by timberland quality class and county, Working Circle 2, (thousand acres).

	County							
Timberland	Mineral		Missoula		Ravalli		Total	
Quality Class	-----thousand acres-----							
	%		%		%		%	
Excellent	24.9	23.3	126.9	20.1	39.8	30.4	191.5	22.0
Good	40.0	37.4	250.6	39.8	58.4	44.6	349.0	40.2
Fair	29.7	27.7	188.6	29.9	20.2	15.5	238.6	27.5
Poor	12.4	11.6	64.3	10.2	12.5	9.5	89.2	10.3
Total	107.0	100.0	630.4	100.0	130.9	100.0	868.3	100.0

\*Indicates less than 50 acres.



Table 91. Area of commercial timberland by habitat type and county, Working Circle 2, (thousand acres).

Habitat Type	County			Total
	Mineral	Missoula	Ravalli	
	-----thousand acres-----			
SCREE	1.2	5.3	0.2	6.7
PIPO/AGSP	-	-	4.4	4.4
PIPO/FEID	0.5	4.6	9.1	14.2
PIPO/PUTR	-	-	0.7	0.7
PIPO/SYAL	1.2	5.5	8.4	15.1
PIPO/PRVI	0.2	0.9	0.2	1.3
PSME	0.4	2.0	0.2	2.6
PSME/AGSP	3.8	21.8	1.7	27.2
PSME/FESC	2.0	8.8	0.4	11.1
PSME/VACA	5.5	29.3	0.2	35.0
PSME/PHMA	24.9	144.3	33.7	202.9
PSME/VAGL	5.4	38.8	6.7	50.9
PSME/LIBO	5.1	24.8	1.5	31.4
PSME/SYAL	12.9	67.0	16.3	96.2
PSME/CARU	8.7	53.4	11.6	73.7
PSME/CAGE	0.8	8.4	5.1	14.3
PSME/ARUV	0.7	2.8	0.2	3.6
PICEA	0.1	1.1	-	1.2
PICEA/CLUN	2.2	9.2	-	11.4
PICEA/GATR	0.3	2.5	2.7	5.5
PICEA/VACA	0.7	4.7	-	5.5
PICEA/LIBO	1.1	4.7	-	5.8
PICEA/SMST	0.7	5.1	-	5.8
ABGR	0.5	3.0	1.0	4.5
ABGR/XETE	0.5	5.0	-	5.5
ABGR/CLUN	1.1	6.4	0.6	8.1
THPL/CLUN	2.7	16.7	-	19.4
ABGR/LIBO	2.3	9.4	8.3	20.0
ABLA/CLUN	6.1	39.1	1.3	46.4
ABLA/GATR	0.2	2.5	-	2.7
ABLA/VACA	1.1	7.3	-	8.4
ABLA/CACA	1.0	7.4	2.7	11.2
ABLA/LIBO	1.6	11.1	8.3	20.9
ABLA/MEFE	3.5	25.0	3.0	31.5
TSME/MEFE	0.5	2.3	-	2.7
ABLA/XETE	6.8	45.0	1.4	53.2
ABLA/VAGL	0.7	2.7	0.1	3.5
ABLA/CARU	0.2	2.6	-	2.8
ABLA/LUHI	0.9	4.8	-	5.7
HARDWOODS	<u>0.1</u>	<u>3.3</u>	<u>6.7</u>	<u>10.2</u>
Total	108.1	638.5	136.9	883.5

Table 92. Area of commercial timberland by salvable dead volume class and county, Working Circle 2, (thousand acres).

Volume Class (Net Cubic Feet Per Acre)	County			
	Missoula	Ravalli	Total	
	-----thousand acres-----			
None	52.2	314.8	76.2	443.1
1 - 100	22.6	127.7	30.8	181.1
101 - 200	14.6	94.9	21.1	130.6
201 - 300	4.1	22.8	6.4	33.3
301 - 400	4.8	24.6	1.0	30.4
401 - 500	2.8	16.6	-	19.5
501 - 600	3.3	13.8	0.8	17.9
601 - 700	1.6	9.6	-	11.1
701 - 800	0.7	7.6	-	8.3
801 - 900	-	-	-	-
901 - 1,000	-	-	-	-
1,001 - 1,100	-	-	-	-
1,101 - 1,200	0.7	3.1	0.2	4.1
1,201 - 1,300	-	-	-	-
1,301 - 1,400	-	-	-	-
1,401 - 1,500	0.5	2.3	-	2.7
1,501 - 1,600	-	-	-	-
1,601 - 1,700	-	-	-	-
1,701 - 1,800	0.2	0.7	0.4	1.3
1,801+	-	-	-	-
Total	108.1	638.5	136.9	833.5

Table 93. Available animal unit months (AUM's) on commercial timberland per acre by condition class, crown density, and county, Working Circle 2.

County and Condition Class	Crown Density				
	0-30	31-50	51-70	71+*	Total
Mineral County	-----AUM's per acre-----				
Excellent	0.24	0.16	0.10	-	0.14
Good	0.13	0.11	0.07	-	0.10
Fair	0.14	0.12	0.04	-	0.10
Poor	0.15	-	0.16	-	0.15
Total	0.16	0.13	0.08	-	0.12
Missoula County					
Excellent	0.26	0.15	0.10	-	0.14
Good	0.15	0.11	0.06	-	0.11
Fair	0.14	0.12	0.05	-	0.11
Poor	0.15	-	0.15	-	0.15
Total	0.18	0.13	0.08	-	0.12
Ravalli County					
Excellent	0.12	0.15	0.07	-	0.10
Good	0.22	0.13	0.07	-	0.14
Fair	0.14	0.09	0.09	-	0.11
Poor	0.12	-	0.04	-	0.09
Total	0.17	0.13	0.07	-	0.12
Working Circle Total					
Excellent	0.24	0.15	0.09	-	0.14
Good	0.16	0.11	0.07	-	0.11
Fair	0.14	0.11	0.06	-	0.10
Poor	0.14	-	0.10	-	0.12
Total	0.17	0.11	0.07	-	0.12

Table 94. Potential available animal unit months (AUM's) on commercial timberland per acre by crown density by county, Working Circle 2.

County	Crown Density				
	0-30	31-50	51-70	71+*	Total
	-----AUM's per acre-----				
Mineral	0.22	0.19	0.10	-	0.16
Missoula	0.25	0.18	0.09	-	0.17
Ravalli	0.29	0.20	0.10	-	0.18
Total	0.25	0.18	0.09	-	0.17

\*No range data was collected on forest land with greater than 70% crown density because the range is considered to have no value for livestock.

### APPENDIX 3. ADDITIONAL SURVEY INFORMATION

Table 95. Area of commercial timberland by forest type, stand size class, and site class, Working Circle 2, (acres).

Forest Type and Stand Size Class	Site Class					All Classes
	165+	120-164	85-119	50-84	20-49	
	-----acres-----					
Douglas-fir						
Sawtimber	-	9,266	42,049	159,100	32,993	243,408
Poletimber	-	-	2,744	46,047	6,825	55,615
Seedlings and saplings	-	2,290	5,408	63,550	22,811	94,058
Nonstocked	-	-	-	2,738	4,108	6,846
Total	-	11,556	50,201	271,435	66,737	399,928
Ponderosa pine						
Sawtimber	-	12,441	44,503	54,347	18,545	129,835
Poletimber	-	-	2,408	2,744	9,930	15,082
Seedlings and saplings	-	733	6,493	21,426	5,780	34,431
Nonstocked	-	-	-	5,405	3,022	8,427
Total	-	13,173	53,404	83,922	37,277	187,775
Lodgepole pine						
Sawtimber	-	2,721	12,830	12,794	7,037	35,382
Poletimber	-	-	18,278	41,018	6,268	65,563
Seedlings and saplings	-	-	2,744	5,514	8,547	16,804
Nonstocked	-	-	-	1,838	-	1,838
Total	-	2,721	33,852	61,164	21,852	119,588
Western larch						
Sawtimber	-	-	9,058	23,247	2,684	34,989
Poletimber	-	-	-	5,656	-	5,656
Seedlings and saplings	-	-	2,684	13,291	8,279	24,254
Nonstocked	-	-	-	1,226	-	1,226
Total	-	-	11,742	43,421	10,963	66,126
Subalpine fir-spruce						
Sawtimber	-	8,212	8,179	13,616	2,721	32,728
Poletimber	-	-	2,721	5,452	1,354	9,526
Seedlings and saplings	-	-	2,738	7,293	2,770	12,801
Nonstocked	-	-	-	-	-	-
Total	-	8,212	13,638	26,361	6,845	55,056

Table 95.

(Page 2)

Forest Type and Stand Size Class	Site Class					All Classes
	165+	120-164	85-119	50-84	20-49	
	-----acres-----					
Spruce						
Sawtimber	-	2,913	16,717	2,738	-	22,367
Poletimber	-	2,913	-	-	-	2,913
Seedlings and saplings	-	-	2,770	-	-	2,770
Nonstocked	-	-	-	-	-	-
Total	-	5,825	19,487	2,738	-	28,050
Western redcedar						
Sawtimber	-	-	2,900	2,738	-	5,638
Poletimber	-	-	-	-	-	-
Seedlings and saplings	-	-	-	-	-	-
Nonstocked	-	-	-	-	-	-
Total	-	-	2,900	2,738	-	5,638
Whitebark pine						
Sawtimber	-	-	-	2,913	-	2,913
Poletimber	-	-	-	-	-	-
Seedlings and saplings	-	-	-	-	-	-
Nonstocked	-	-	-	-	-	-
Total	-	-	-	2,913	-	2,913
Grand fir						
Sawtimber	-	-	-	-	-	-
Poletimber	-	-	-	-	-	-
Seedlings and saplings	-	-	-	2,500	-	2,500
Nonstocked	-	-	-	-	-	-
Total	-	-	-	2,500	-	2,500
Juniper						
Sawtimber	-	-	-	-	-	-
Poletimber	-	-	-	-	-	-
Seedlings and saplings	-	-	-	-	-	-
Nonstocked	-	-	-	733	-	733
Total	-	-	-	733	-	733
Total softwoods						
Sawtimber	-	35,552	136,235	271,494	63,980	507,261
Poletimber	-	2,913	26,150	100,915	24,377	154,355
Seedlings and saplings	-	3,022	22,838	113,574	48,187	187,620
Nonstocked	-	-	-	11,940	7,130	19,070
Total	-	41,487	185,223	497,923	143,673	868,306



Table 95.

(Page 3)

Forest Type and Stand Size Class	Site Class					All Classes
	165+	120-164	85-119	50-84	20-49	
	-----acres-----					
Cottonwood						
Sawtimber	-	-	5,953	3,232	-	9,185
Poletimber	-	-	-	-	-	-
Seedlings and saplings	-	-	-	-	1,616	1,616
Nonstocked	-	-	-	-	3,059	3,059
Total	-	-	5,953	3,232	4,675	13,860
Aspen						
Sawtimber	-	-	-	-	-	-
Poletimber	-	-	-	-	-	-
Seedlings and saplings	-	-	1,344	-	-	1,344
Nonstocked	-	-	-	-	-	-
Total	-	-	1,344	-	-	1,344
Total hardwoods						
Sawtimber	-	-	5,953	3,232	-	9,185
Poletimber	-	-	-	-	-	-
Seedlings and saplings	-	-	1,344	-	1,616	2,960
Nonstocked	-	-	-	-	3,059	3,059
Total	-	-	7,297	3,232	4,675	15,204
All types						
Sawtimber	-	35,552	142,188	274,726	63,980	516,445
Poletimber	-	2,913	26,150	100,915	24,377	154,355
Seedlings and saplings	-	3,022	24,182	113,574	49,803	190,580
Nonstocked	-	-	-	11,940	10,190	22,130
Total	-	41,487	192,520	501,155	148,349	883,510

Table 96. Area of commercial timberland by forest type, stand size class, and site class for state and other public ownership, Working Circle 2, (acres).

Forest Type and Stand Size Class	Site Class					All Classes
	165+	120-164	85-119	50-84	20-49	
	-----acres-----					
Douglas fir						
Sawtimber	-	1,703	9,203	29,465	6,148	46,519
Poletimber	-	-	-	8,143	1,338	9,481
Seedlings and saplings	-	443	2,638	5,833	1,072	9,987
Nonstocked	-	-	-	-	1,338	1,338
Total	-	2,147	11,841	43,441	9,896	67,324
Ponderosa pine						
Sawtimber	-	3,618	7,551	10,058	3,511	24,738
Poletimber	-	-	35	-	733	768
Seedlings and saplings	-	46	1,216	1,251	339	2,852
Nonstocked	-	-	-	-	489	489
Total	-	3,665	8,802	11,308	5,072	28,847
Lodgepole pine						
Sawtimber	-	-	5,163	968	1,675	7,805
Poletimber	-	-	3,746	3,172	932	7,850
Seedlings and saplings	-	-	-	-	912	912
Nonstocked	-	-	-	762	-	762
Total	-	-	8,908	4,902	3,520	17,330
Western larch						
Sawtimber	-	-	896	4,391	-	5,287
Poletimber	-	-	-	321	-	321
Seedlings and saplings	-	-	-	35	-	35
Nonstocked	-	-	-	150	-	150
Total	-	-	896	4,897	-	5,793
Subalpine fir-spruce						
Sawtimber	-	-	-	-	-	-
Poletimber	-	-	-	134	1,354	1,488
Seedlings and saplings	-	-	-	762	-	762
Nonstocked	-	-	-	-	-	-
Total	-	-	-	896	1,354	2,250
Spruce						
Sawtimber	-	321	1,658	-	-	1,979
Poletimber	-	321	-	-	-	321
Seedlings and saplings	-	-	-	-	-	-
Nonstocked	-	-	-	-	-	-
Total	-	641	1,658	-	-	2,300

Table 96.

(Page 2)

Forest Type and Stand Size Class	Site Class					All Classes
	165+	120-164	85-119	50-84	20-49	
	-----acres-----					
Western redcedar						
Sawtimber	-	-	244	-	-	244
Poletimber	-	-	-	-	-	-
Seedlings and saplings	-	-	-	-	-	-
Nonstocked	-	-	-	-	-	-
Total	-	-	244	-	-	244
Whitebark pine						
Sawtimber	-	-	-	321	-	321
Poletimber	-	-	-	-	-	-
Seedlings and saplings	-	-	-	-	-	-
Nonstocked	-	-	-	-	-	-
Total	-	-	-	321	-	321
Grand fir						
Sawtimber	-	-	-	-	-	-
Poletimber	-	-	-	-	-	-
Seedlings and saplings	-	-	-	232	-	232
Nonstocked	-	-	-	-	-	-
Total	-	-	-	232	-	232
Juniper						
Sawtimber	-	-	-	-	-	-
Poletimber	-	-	-	-	-	-
Seedlings saplings	-	-	-	-	-	-
Nonstocked	-	-	-	46	-	46
Total	-	-	-	46	-	46
Total softwoods						
Sawtimber	-	5,642	24,715	45,203	11,334	86,894
Poletimber	-	321	3,781	11,770	4,357	20,228
Seedlings and saplings	-	490	3,855	8,112	2,323	14,780
Nonstocked	-	-	-	959	1,827	2,786
Total	-	6,453	32,350	66,043	19,842	124,687

Table 96.  
(Page 3)

Forest Type and Stand Size Class	Site Class					All Classes
	165+	120-164	85-119	50-84	20-49	
	-----acres-----					
Cottonwood						
Sawtimber	-	-	228	228	-	455
Poletimber	-	-	-	-	-	-
Seedlings and saplings	-	-	-	-	114	114
Nonstocked	-	-	-	-	339	339
Total	-	-	228	228	452	908
Aspen						
Sawtimber	-	-	-	-	-	-
Poletimber	-	-	-	-	-	-
Seedlings and saplings	-	-	658	-	-	658
Nonstocked	-	-	-	-	-	-
Total	-	-	658	-	-	658
Total hardwoods						
Sawtimber	-	-	228	228	-	455
Poletimber	-	-	-	-	-	-
Seedlings and saplings	-	-	658	-	114	772
Nonstocked	-	-	-	-	339	339
Total	-	-	886	228	452	1,566
All types						
Sawtimber	-	5,642	24,942	45,430	11,334	87,349
Poletimber	-	321	3,781	11,770	4,357	20,228
Seedlings and saplings	-	490	4,513	8,112	2,437	15,552
Nonstocked	-	-	-	959	2,166	3,125
Total	-	6,453	33,235	66,271	20,294	126,253

Table 97. Area of commercial timberland by forest type, stand size class, and MAI site class for forest industry ownership, Working Circle 2, (acres).

Forest Type and Stand Size Class	Site Class					All Classes
	165+	120-164	85-119	50-84	20-49	
	-----acres-----					
Douglas fir						
Sawtimber	-	3,705	20,059	91,228	21,833	136,824
Poletimber	-	-	2,744	23,116	5,487	31,347
Seedlings and saplings	-	904	2,770	40,156	12,175	56,005
Nonstocked	-	-	-	2,738	2,770	5,509
Total	-	4,608	25,573	157,239	42,266	229,685
Ponderosa pine						
Sawtimber	-	520	14,368	9,613	9,079	33,580
Poletimber	-	-	422	2,744	2,744	5,909
Seedlings and saplings	-	90	2,684	13,788	2,721	19,282
Nonstocked	-	-	-	5,405	993	6,398
Total	-	610	17,474	31,549	15,536	65,168
Lodgepole pine						
Sawtimber	-	2,721	-	5,540	2,770	11,030
Poletimber	-	-	5,487	27,414	2,744	35,645
Seedlings and saplings	-	-	2,744	5,514	5,482	13,740
Nonstocked	-	-	-	-	-	-
Total	-	2,721	8,231	38,467	10,996	60,415
Western larch						
Sawtimber	-	-	8,162	14,393	2,684	25,239
Poletimber	-	-	-	2,744	-	2,744
Seedlings and saplings	-	-	2,684	11,304	8,279	22,267
Nonstocked	-	-	-	-	-	-
Total	-	-	10,846	28,441	10,963	50,250
Subalpine fir-spruce						
Sawtimber	-	8,212	8,179	13,616	2,721	32,728
Poletimber	-	-	2,721	3,510	-	6,231
Seedlings and saplings	-	-	2,738	5,455	2,770	10,963
Nonstocked	-	-	-	-	-	-
Total	-	8,212	13,638	22,581	5,491	49,922

Table 97.

(Page 2)

Forest Type and Stand Size Class	Site Class					All Classes
	165+	120-164	85-119	50-84	20-49	
	-----acres-----					
Spruce						
Sawtimber	-	-	10,998	2,738	-	13,737
Poletimber	-	-	-	-	-	-
Seedlings and saplings	-	-	2,770	-	-	2,770
Nonstocked	-	-	-	-	-	-
Total	-	-	13,769	2,738	-	16,507
Western redcedar						
Sawtimber	-	-	-	2,738	-	2,738
Poletimber	-	-	-	-	-	-
Seedlings and saplings	-	-	-	-	-	-
Nonstocked	-	-	-	-	-	-
Total	-	-	-	2,738	-	2,738
Whitebark pine						
Sawtimber	-	-	-	-	-	-
Poletimber	-	-	-	-	-	-
Seedlings and saplings	-	-	-	-	-	-
Nonstocked	-	-	-	-	-	-
Total	-	-	-	-	-	-
Grand fir						
Sawtimber	-	-	-	-	-	-
Poletimber	-	-	-	-	-	-
Seedlings and saplings	-	-	-	217	-	217
Nonstocked	-	-	-	-	-	-
Total	-	-	-	217	-	217
Juniper						
Sawtimber	-	-	-	-	-	-
Poletimber	-	-	-	-	-	-
Seedlings and saplings	-	-	-	-	-	-
Nonstocked	-	-	-	90	-	90
Total	-	-	-	90	-	90
Total softwoods						
Sawtimber	-	15,157	61,766	139,866	39,087	255,876
Poletimber	-	-	11,373	59,528	10,975	81,876
Seedlings and saplings	-	993	16,391	76,433	31,427	125,244
Nonstocked	-	-	-	8,233	3,763	11,996
Total	-	16,150	89,531	284,060	85,252	474,991



Table 97.

(Page 3)

Forest Type and Stand Size Class	Site Class					All Classes
	165+	120-164	85-119	50-84	20-49	
	-----acres-----					
Cottonwood						
Sawtimber	-	-	2,917	197	-	3,114
Poletimber	-	-	-	-	-	-
Seedlings and saplings	-	-	-	-	98	98
Nonstocked	-	-	-	-	-	-
Total	-	-	2,917	197	98	3,212
Aspen						
Sawtimber	-	-	-	-	-	-
Poletimber	-	-	-	-	-	-
Seedlings and saplings	-	-	90	-	-	90
Nonstocked	-	-	-	-	-	-
Total	-	-	90	-	-	90
Total hardwoods						
Sawtimber	-	-	2,917	197	-	3,114
Poletimber	-	-	-	-	-	-
Seedlings and saplings	-	-	90	-	98	188
Nonstocked	-	-	-	-	-	-
Total	-	-	3,007	197	98	3,302
All types						
Sawtimber	-	15,157	64,683	140,063	39,087	258,989
Poletimber	-	-	11,373	59,528	10,975	81,876
Seedlings and saplings	-	993	16,481	76,433	31,525	125,432
Nonstocked	-	-	-	8,233	3,763	11,996
Total	-	16,150	92,537	284,256	85,350	478,293

Table 98. Area of commercial timberland by forest type, stand size class, and site class for other private ownership, Working Circle 2, (acres).

Forest type and Stand Size Class	Site Class					All Classes
	165+	120-164	85-119	50-84	20-49	
	-----acres-----					
Douglas fir						
Sawtimber	-	3,858	12,788	38,407	5,012	60,065
Poletimber	-	-	-	14,787	-	14,787
Seedlings and saplings	-	943	-	17,561	9,563	28,067
Nonstocked	-	-	-	-	-	-
Total	-	4,801	12,788	70,755	14,575	102,919
Ponderosa pine						
Sawtimber	-	8,302	22,584	34,677	5,955	71,517
Poletimber	-	-	1,952	-	6,453	8,405
Seedlings and saplings	-	597	2,592	6,388	2,721	12,298
Nonstocked	-	-	-	-	1,540	1,540
Total	-	8,899	27,127	41,065	16,668	93,759
Lodgepole pine						
Sawtimber	-	-	7,668	6,287	2,592	16,546
Poletimber	-	-	9,045	10,432	2,592	22,069
Seedlings and saplings	-	-	-	-	2,152	2,152
Nonstocked	-	-	-	1,076	-	1,076
Total	-	-	16,713	17,795	7,336	41,843
Western larch						
Sawtimber	-	-	-	4,463	-	4,463
Poletimber	-	-	-	2,592	-	2,592
Seedlings and saplings	-	-	-	1,952	-	1,952
Nonstocked	-	-	-	1,076	-	1,076
Total	-	-	-	10,083	-	10,083
Subalpine fir-spruce						
Sawtimber	-	-	-	-	-	-
Poletimber	-	-	-	1,807	-	1,807
Seedlings and saplings	-	-	-	1,076	-	1,076
Nonstocked	-	-	-	-	-	-
Total	-	-	-	2,884	-	2,884
Spruce						
Sawtimber	-	2,592	4,060	-	-	6,652
Poletimber	-	2,592	-	-	-	2,592
Seedlings saplings	-	-	-	-	-	-
Nonstocked	-	-	-	-	-	-
Total	-	5,184	4,060	-	-	9,244

Table 98.

(Page 2)

Forest Type and Stand Size Class	Site Class					All Classes
	165+	120-164	85-119	50-84	20-49	
	-----acres-----					
Western redcedar						
Sawtimber	-	-	2,656	-	-	2,656
Poletimber	-	-	-	-	-	-
Seedlings and saplings	-	-	-	-	-	-
Nonstocked	-	-	-	-	-	-
Total	-	-	2,656	-	-	2,656
Whitebark pine						
Sawtimber	-	-	-	2,592	-	2,592
Poletimber	-	-	-	-	-	-
Seedlings and saplings	-	-	-	-	-	-
Nonstocked	-	-	-	-	-	-
Total	-	-	-	2,592	-	2,592
Grand fir						
Sawtimber	-	-	-	-	-	-
Poletimber	-	-	-	-	-	-
Seedlings and saplings	-	-	-	2,051	-	2,051
Nonstocked	-	-	-	-	-	-
Total	-	-	-	2,051	-	2,051
Juniper						
Sawtimber	-	-	-	-	-	-
Poletimber	-	-	-	-	-	-
Seedlings and saplings	-	-	-	-	-	-
Nonstocked	-	-	-	597	-	597
Total	-	-	-	597	-	597
Total softwoods						
Sawtimber	-	14,753	49,755	86,425	13,558	164,491
Poletimber	-	2,592	10,997	29,618	9,045	52,252
Seedlings and saplings	-	1,540	2,592	29,028	14,436	47,596
Nonstocked	-	-	-	2,749	1,540	4,289
Total	-	18,884	63,343	147,821	38,579	268,628

Table 98.

(Page 3)

Forest Type and  
Stand Size Class

	Site Class					All Classes
	165+	120-164	85-119	50-84	20-49	
	-----acres-----					
Cottonwood						
Sawtimber	-	-	2,808	2,808	-	5,616
Poletimber	-	-	-	-	-	-
Seedlings and saplings	-	-	-	-	1,404	1,404
Nonstocked	-	-	-	-	2,721	2,721
Total	-	-	2,808	2,808	4,125	9,740
Aspen						
Sawtimber	-	-	-	-	-	-
Poletimber	-	-	-	-	-	-
Seedlings and saplings	-	-	597	-	-	597
Nonstocked	-	-	-	-	-	597
Total	-	-	597	-	-	597
Total hardwoods						
Sawtimber	-	-	2,808	2,808	-	5,616
Poletimber	-	-	-	-	-	-
Seedlings and saplings	-	-	597	-	1,404	2,001
Nonstocked	-	-	-	-	2,721	2,721
Total	-	-	3,405	2,808	4,125	10,337
All types						
Sawtimber	-	14,753	52,562	89,233	13,558	170,107
Poletimber	-	2,592	10,997	29,618	9,045	52,252
Seedlings and saplings	-	1,540	3,189	29,028	15,840	49,597
Nonstocked	-	-	-	2,749	4,261	7,010
Totals	-	18,884	66,748	150,629	42,704	278,965

Table 99. Area of commercial timberland by stand volume class and ownership group, Working Circle 2, (thousand acres).

Cubic Foot Volume Class	Ownership Group							
	State and Other Public		Forest Industry		Other Private		Total	
	-----thousand		acres-----		-----		-----	
	%		%		%		%	
Less than 500	10.3	8.2	87.5	18.3	45.2	16.2	143.0	16.2
500 - 1,499	51.1	40.5	183.8	38.4	109.3	39.2	344.2	38.9
1,500 - 2,499	37.9	30.0	125.4	26.2	77.1	27.6	240.3	27.2
2,500 - 3,499	19.1	15.1	31.3	6.6	34.7	12.4	85.0	9.6
3,500 - 4,999	6.5	5.1	36.3	7.6	10.8	3.9	53.5	6.1
Over 5,000	1.4	1.1	14.1	2.9	2.0	0.7	17.4	2.0
Total all classes	126.3	100.0	478.3	100.0	279.0	100.0	883.5	100.0

Table 100. Area of commercial timberland by primary habitat type and M.A.I. site class, Working Circle 2, (thousand acres).

Habitat Type	Site Class (Ft <sup>3</sup> /Acre/Year)					Total
	20-49	50-84	85-119	120-164	165+	
	-----thousand acres-----					
Scree	3.1	3.6	-	-	-	6.7
PIPO/AGSP	-	1.9	2.5	-	-	4.4
PIPO/FEID	-	7.1	4.1	3.0	-	14.2
PIPO/PUTR	0.7	-	-	-	-	0.7
PIPO/SYAL	2.9	4.9	4.9	2.4	-	15.1
PIPO/PRVI	-	-	1.3	-	-	1.3
PSME	1.3	1.2	-	-	-	2.6
PSME/AGSP	18.2	9.0	-	-	-	27.2
PSME/FESC	5.3	5.7	-	-	-	11.1
PSME/VACA	8.9	16.9	9.3	-	-	35.0
PSME/PHMA	27.7	138.4	27.6	9.3	-	202.9
PSME/VAGL	10.3	29.7	10.9	-	-	50.9
PSME/LIBO	1.2	24.8	5.4	-	-	31.4
PSME/SYAL	8.2	51.0	31.0	6.1	-	96.2
PSME/CARU	17.9	48.9	5.5	1.3	-	73.7
PSME/CAGE	2.8	9.1	2.4	-	-	14.3
PSME/ARUV	-	0.9	2.7	-	-	3.6
PICEA	-	1.2	-	-	-	1.2
PICEA/CLUN	-	-	2.9	8.5	-	11.4
PICEA/GATR	-	2.8	2.7	-	-	5.5
PICEA/VACA	-	2.7	2.7	-	-	5.5
PICEA/LIBO	-	2.9	2.9	-	-	5.8
PICEA/SMST	-	2.8	3.1	-	-	5.5
ABGR	-	1.6	2.9	-	-	4.5
ABGR/XETE	-	2.7	2.7	-	-	5.5
ABGR/CLUN	-	5.5	2.7	-	-	8.1
THPL/CLUN	-	5.6	13.8	-	-	19.4
ABGR/LIBO	-	17.3	2.7	-	-	20.0
ABLA/CLUN	-	21.7	16.6	8.2	-	46.4
ABLA/GATR	-	-	2.7	-	-	2.7
ABLA/VACA	2.9	2.8	2.7	-	-	8.4
ABLA/CACA	2.8	5.7	2.7	-	-	11.2
ABLA/LIBO	1.8	16.4	2.7	-	-	20.9
ABLA/MEFE	11.7	11.5	5.5	2.8	-	31.5
TSME/MEFE	-	2.7	-	-	-	2.7
ABLA/XETE	19.0	28.7	5.5	-	-	53.2
ABLA/VAGL	-	3.5	-	-	-	3.5
ABLA/CARU	-	-	2.8	-	-	2.8
ABLA/LUHI	-	5.7	-	-	-	5.7
Hardwood	<u>1.6</u>	<u>4.0</u>	<u>4.6</u>	<u>-</u>	<u>-</u>	<u>10.2</u>
Total	148.3	501.2	192.5	41.5	-	883.5

Table 101. Area of commercial timberland by forest type, fuel loads per acre, and ownership group, Working Circle 2, (thousand acres).

Ownership Group and Forest Type	Fuel Loads Per Acre Total Tons/Acre									
	0 to 10.0 Tons			10.1 to 25.0 Tons			25.1 + Tons			
	Fine Fuel Loads			Fine Fuel Loads			Fine Fuel Loads			
	-----Tons Per Acre-----			-----Tons Per Acre-----			-----Tons Per Acre-----			
	0-1.0	1.1-5.0	5.1+	0-1.0	1.1-5.0	5.1+	0-1.0	1.1-5.0	5.1+	Total
State and Other Public	-----thousand acres-----									
Douglas-fir	8.8	13.1	0.9	0.4	19.7	10.4	-	9.1	4.8	67.3
Ponderosa pine	7.1	8.8	-	0.5	11.2	0.7	-	-	0.5	28.8
Lodgepole pine	0.7	3.7	0.3	-	6.1	1.8	-	4.2	0.5	17.3
Western larch	0.2	1.3	-	0.3	-	1.4	-	1.6	1.0	5.8
Other softwoods	0.2	-	-	-	-	1.8	-	2.1	1.3	5.4
Total softwoods	17.0	27.0	1.3	1.2	37.0	16.1	-	17.0	8.1	124.7
Total hardwoods	0.7	0.3	0.3	-	0.2	-	-	-	-	1.6
Total all types	17.7	27.3	1.6	1.2	37.2	16.1	-	17.0	8.1	126.3
Forest Industry										
Douglas-fir	23.9	41.4	3.7	3.6	42.6	45.9	2.7	22.2	43.6	229.7
Ponderosa pine	11.8	17.0	-	3.0	17.0	8.2	-	2.7	5.5	65.2
Lodgepole pine	-	11.1	2.8	5.5	13.7	11.0	-	8.2	8.2	60.4
Western larch	2.8	-	-	-	10.9	5.9	-	13.7	17.1	50.2
Other softwoods	-	-	-	5.5	11.0	5.5	5.5	24.7	17.4	69.5
Total softwoods	38.5	69.4	6.4	17.6	95.1	76.5	8.2	71.4	91.8	475.0
Total hardwoods	0.1	0.3	-	-	0.2	-	-	2.7	-	3.3
Total all types	38.6	69.7	6.4	17.6	95.3	76.5	8.2	74.2	91.8	478.3



Fuel Loads Per Acre  
Total Tons/Acre

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Table 102. Net volume per acre of growing stock on commercial timberland by forest type and ownership group, Working Circle 2, (thousand cubic feet per acre).

Forest Type	Ownership Group			
	State and Other Public	Forest Industry	Other Private	All Owners
	-----thousand cubic feet per acre-----			
Douglas fir	1.5	1.3	1.3	1.3
Ponderosa pine	1.4	1.1	1.4	1.3
Lodgepole pine	2.6	2.5	2.1	2.4
Western larch	2.0	1.2	1.8	1.4
Subalpine fir-spruce	1.2	2.4	0.7	2.2
Spruce	3.3	3.0	3.0	3.0
Western redcedar	3.0	3.7	3.0	3.3
Whitebark pine	2.6	-	2.6	2.6
Grand fir	0.2	0.2	0.2	0.2
Juniper	0.1	0.1	0.1	0.1
Softwood types	1.7	1.6	1.5	1.6
Cottonwood	0.8	3.3	0.9	1.5
Aspen	0.5	0.2	0.2	0.4
Hardwood types	0.7	3.2	0.9	1.4
All forest types	1.7	1.6	1.5	1.6

Table 103. Net volume per acre of sawtimber on commercial timberland by forest type and ownership group, Working Circle 2, (thousand board feet Scribner per acre).

	Ownership Group			
	State and Other Public	Forest Industry	Other Private	All Owners
	-----thousand board feet per acre-----			
Douglas fir	5.1	4.0	4.0	4.2
Ponderosa pine	5.5	3.7	4.9	4.6
Lodgepole pine	6.3	3.0	3.9	3.8
Western larch	6.8	4.7	5.9	5.0
Subalpine fir-spruce	1.4	9.0	0.8	8.3
Spruce	8.7	13.0	9.7	11.6
Western redcedar	6.4	15.7	6.4	10.9
Whitebark pine	7.4	-	7.4	7.4
Grand fir	0.3	0.3	0.3	0.3
Juniper	0.3	0.3	0.3	0.3
Softwood types	5.4	4.8	4.6	4.8
Cottonwood	3.4	12.5	3.8	5.8
Aspen	0.9	0.8	0.8	0.9
Hardwood types	2.3	12.2	3.7	5.4
All forest types	5.4	4.9	4.5	4.8

Table 104. Net volume of growing stock on commercial timberland by forest type and species, Working Circle 2, (thousand cubic feet).

Forest Type	Softwood Species								
	Douglas- fir	Ponderosa pine	Lodgepole pine	Western larch	Subalpine fir	Spruce	Western redcedar	Whitebark pine	Grand fir
Douglas-fir	368,275	66,099	44,183	41,765	8,434	-	-	107	1,203
Ponderosa pine	30,766	200,624	1,075	3,642	-	391	-	-	369
Lodgepole pine	15,292	4,380	220,990	26,051	6,342	3,243	-	626	720
Western larch	20,267	3,892	6,797	48,293	2,962	3,612	-	-	3,922
Subalpine fir-spruce	16,644	-	12,037	14,782	33,012	47,344	-	-	-
Spruce	2,517	418	10,771	11,899	3,302	49,952	1,952	-	-
Western redcedar	3,090	-	1,128	5,298	532	790	5,430	-	1,735
Whitebark pine	-	-	564	-	2,046	261	-	4,708	-
Grand fir	562	-	-	-	-	-	-	-	-
Juniper	-	-	-	-	60	-	-	-	-
Softwood types	457,412	275,413	297,544	151,730	56,689	109,198	7,383	5,441	7,949
Cottonwood	-	1,919	-	1,126	-	2,043	397	-	-
Aspen	-	151	-	-	-	-	-	-	-
Hardwood types	-	2,070	-	1,126	-	2,043	397	-	-
Total all types	457,412	277,483	297,544	152,856	56,689	111,241	7,780	5,441	7,949

Table 104.  
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Forest Type	Western white pine	Total softwood species	Hardwood Species				Total : all species
			Cottonwood -----thousand cubic feet-----	Aspen	Other hardwoods	hardwood species	
Douglas-fir	-	533,669	198	-	-	198	533,867
Ponderosa pine	-	236,866	1,456	459	-	1,915	238,780
Lodgepole pine	-	277,643	509	4,063	-	4,572	282,215
Western larch	352	90,097	-	-	-	-	90,097
Subalpine fir-spruce	-	123,819	-	-	-	-	123,819
Spruce	307	81,119	941	2,597	-	3,538	84,656
Western redcedar	799	18,804	-	-	-	-	18,804
Whitebark pine	-	7,579	-	-	-	-	7,579
Grand fir	-	562	-	-	-	-	562
Juniper	-	60	-	-	-	-	60
Softwood types	1,458	1,370,217	3,103	7,118	-	10,222	1,380,440
Cottonwood	-	5,485	12,649	216	2,161	15,026	20,511
Aspen	-	151	-	331	-	331	481
Hardwood types	-	5,636	12,649	547	2,161	15,357	20,992
Total all types	1,458	1,375,853	15,752	7,665	2,161	25,579	1,401,432

Table 105. Net volume of sawtimber on commercial timberland by forest type and species, Working Circle 2, (thousand board feet Scribner).

Softwood Species

	Douglas- fir	Ponderosa pine	Lodgepole pine	Western larch	Subalpine fir
	-----thousand board feet-----				
Douglas-fir	1,118,692	260,726	107,250	155,907	16,295
Ponderosa pine	87,189	745,992	4,425	12,789	-
Lodgepole pine	38,878	19,568	286,748	86,164	3,965
Western larch	64,155	20,088	10,810	207,713	5,121
Subalpine fir-spruce	68,973	-	29,235	62,063	75,126
Spruce	10,669	2,190	28,664	63,145	8,894
Western redcedar	10,637	-	-	18,752	1,987
Whitebark pine	-	-	2,210	-	4,290
Grand fir	656	-	-	-	-
Juniper	-	-	-	-	248
Softwood types	1,399,848	1,048,563	469,342	606,534	115,925
Cottonwood	-	9,548	-	4,765	-
Aspen	-	619	-	-	-
Hardwood types	-	10,167	-	4,765	-
Total all types	1,399,848	1,058,730	469,342	611,299	115,925

	Spruce	Western redcedar	Whitebark pine	Grand fir	Western white pine	Total softwood species
	-----thousand board feet-----					
Douglas-fir	11,889	-	-	4,807	-	1,675,564
Ponderosa pine	1,872	-	-	1,692	-	853,959
Lodgepole pine	8,679	-	1,762	1,456	-	447,220
Western larch	13,609	-	-	10,521	1,571	333,589
Subalpine fir-spruce	218,963	-	-	-	-	454,361
Spruce	187,683	7,166	-	-	1,324	309,734
Western redcedar	1,901	19,622	-	4,704	4,007	61,611
Whitebark pine	1,082	-	14,023	-	-	21,604
Grand fir	-	-	-	-	-	656
Juniper	-	-	-	-	-	248
Softwood types	445,678	26,788	15,785	23,180	6,902	4,158,544
Cottonwood	8,271	1,637	-	-	-	24,222
Aspen	-	-	-	-	-	619
Hardwood types	8,271	1,637	-	-	-	24,841
Total all types	453,949	28,425	15,785	23,180	6,902	4,183,385

Table 105.

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Hardwood Species

	Cottonwood	Aspen	Other hardwoods	Total hardwood species	Total all species
	-----thousand board feet-----				
Douglas-fir	843	-	-	843	1,676,407
Ponderosa pine	5,987	533	-	6,520	860,479
Lodgepole pine	1,549	3,999	-	5,548	452,767
Western larch	-	-	-	-	333,589
Subalpine fir-spruce	-	-	-	-	454,361
Spruce	3,315	11,402	-	14,718	324,451
Western redcedar	-	-	-	-	61,611
Whitebark pine	-	-	-	-	21,604
Grand fir	-	-	-	-	656
Juniper	-	-	-	-	248
Softwood types	11,695	15,933	-	27,628	4,186,172
Cottonwood	50,926	-	5,347	56,274	80,496
Aspen	-	542	-	542	1,160
Hardwood types	50,926	542	5,347	56,816	81,656
Total all types	62,621	16,475	5,347	84,444	4,267,828



Table 106. Net volume of growing stock on commercial timberland by diameter class and species, Working Circle 2, (thousand cubic feet).

Diameter Class	Species						
	Douglas- fir	Lodgepole pine	Ponderosa pine	Western larch	Subalpine fir	Grand fir	Western redcedar limber pine
	thousand cubic feet						
5.0 - 6.9	47,273	85,779	8,275	10,666	17,173	588	7,871
7.0 - 8.9	71,242	96,711	21,441	16,463	10,913	1,431	5,972
9.0 - 10.9	72,070	60,913	31,566	15,698	9,718	1,794	10,765
11.0 - 12.9	69,727	28,843	36,328	15,254	4,756	428	12,759
13.0 - 14.9	49,683	17,531	43,431	12,035	3,349	365	13,507
15.0 - 16.9	46,215	5,023	33,912	13,071	4,768	1,130	13,565
17.0 - 18.9	34,374	2,008	27,247	9,945	1,655	916	10,491
19.0 - 20.9	25,398	471	21,075	9,016	1,285	355	6,435
21.0 - 22.9	15,165	266	12,963	15,500	916	408	7,378
23.0 - 24.9	7,875	-	14,067	7,660	1,064	204	4,450
25.0 - 26.9	8,170	-	7,471	5,757	290	331	4,276
27.0 - 28.9	3,357	-	4,846	6,017	311	-	334
29.0+	6,863	-	14,859	15,772	493	-	13,437
All Classes	457,412	297,544	277,483	152,856	56,689	7,949	111,241
							7,780
							5,441

Diameter Class	Total			Total		
	Western white pine	softwood species	Aspen	Other hardwoods	hardwood species	Total all species
	thousand cubic feet			thousand cubic feet		
5.0 - 6.9	-	178,250	1,112	-	1,461	179,710
7.0 - 8.9	-	225,498	590	206	1,060	226,559
9.0 - 10.9	-	204,645	2,210	737	3,053	207,698
11.0 - 12.9	659	171,266	1,247	-	2,166	173,431
13.0 - 14.9	-	141,378	725	467	1,577	142,955
15.0 - 16.9	355	119,766	-	510	1,023	120,789
17.0 - 18.9	-	87,083	349	-	1,157	88,240
19.0 - 20.9	-	65,078	-	242	1,006	66,084
21.0 - 22.9	-	53,157	332	-	1,252	54,409
23.0 - 24.9	-	35,640	741	-	1,471	37,111
25.0 - 26.9	444	27,065	-	-	835	27,900
27.0 - 28.9	-	15,207	358	-	1,072	16,279
29+	-	51,821	-	-	8,446	60,267
All Classes	1,458	1,375,853	7,665	2,161	25,579	1,401,432

Table 107. Net volume of sawtimber on commercial timberland by diameter class and species, Working Circle 2, (thousand board feet Scribner).

Diameter Class	Species								
	Douglas- fir	Lodgepole pine	Ponderosa pine	Western larch	Subalpine fir	Grand fir	Spruce	Western redcedar	Whitebark- limber pine
9.0 - 10.9	198,566	206,131	61,905	52,511	30,641	5,353	37,530	2,273	4,877
11.0 - 12.9	269,553	139,207	126,057	63,058	19,808	1,624	57,943	2,515	8,765
13.0 - 14.9	215,388	86,065	181,228	56,154	14,739	1,540	62,334	4,430	1,547
15.0 - 16.9	214,354	24,594	157,831	64,388	21,583	5,220	62,830	6,631	-
17.0 - 18.9	165,324	9,780	133,811	50,572	7,668	4,019	48,576	1,204	596
19.0 - 20.9	124,939	2,273	106,510	46,864	6,151	1,503	29,791	3,867	-
21.0 - 22.9	76,542	1,293	66,796	83,077	4,492	1,728	35,465	2,118	-
23.0 - 24.9	39,952	-	73,338	42,269	5,264	850	22,215	1,198	-
25.0 - 26.9	42,040	-	39,107	32,036	1,452	1,345	21,831	1,225	-
27.0 - 28.9	17,387	-	26,176	33,466	1,588	-	1,738	1,323	-
29.0+	35,804	-	85,973	86,904	2,540	-	73,694	1,637	-
All Classes	1,399,848	469,342	1,058,730	611,299	115,925	23,180	453,949	28,425	15,785

Diameter Class	Total :					Total :		
	Western white pine	softwood species	Aspen	Cottonwood	Other hardwoods	hardwood species	all species	
9.0 - 10.9	-	599,787	-	-	-	-	599,787	
11.0 - 12.9	2,895	691,424	5,521	3,919	-	9,441	700,864	
13.0 - 14.9	-	623,425	3,319	1,656	2,040	7,016	630,441	
15.0 - 16.9	1,710	559,140	-	2,176	2,265	4,441	563,581	
17.0 - 18.9	-	421,551	1,571	3,414	-	4,985	426,535	
19.0 - 20.9	-	321,898	-	3,155	1,042	4,197	326,096	
21.0 - 22.9	-	271,510	1,427	3,727	-	5,154	276,664	
23.0 - 24.9	-	185,086	3,134	2,924	-	6,058	191,144	
25.0 - 26.9	2,298	141,333	-	3,362	-	3,362	144,695	
27.0 - 28.9	-	81,678	1,503	2,915	-	4,417	86,095	
29+	-	286,552	-	35,374	-	35,374	321,926	
All Classes	6,902	4,183,385	16,475	62,621	5,347	84,444	4,267,828	

Table 108. Net volume of sawtimber on commercial softwood timberland by stand size class, timberland quality class, and ownership group, Working Circle 2, (thousand board feet Scribner).

Ownership Group and Stand Size Class	Timberland Quality Class				Total
	Excellent	Good	Fair	Poor	
	-----thousand board feet-----				
State and Other Public					
Old growth sawtimber	50,145	82,390	87,272	25,928	245,735
Young growth sawtimber	229,365	81,472	28,574	15,429	354,840
Poletimber	10,354	24,624	12,948	526	48,453
Seedlings and saplings	11,247	11,713	1,516	2,148	26,624
Nonstocked	-	16	593	-	609
Total	301,111	200,214	130,903	44,032	676,259
Forest Industry					
Old growth sawtimber	492,496	276,669	282,366	184,075	1,235,606
Young growth sawtimber	264,201	184,194	107,537	83,328	639,260
Poletimber	35,877	98,921	55,090	9,412	199,299
Seedlings and saplings	7,441	111,961	51,362	32,292	203,056
Nonstocked	-	3,706	2,770	-	6,477
Total	800,016	675,451	499,125	309,106	2,283,697
Other Private					
Old growth sawtimber	107,543	71,876	126,476	34,573	340,468
Young growth sawtimber	408,312	170,809	50,760	69,932	699,813
Poletimber	50,343	64,217	9,973	4,215	128,748
Seedlings and saplings	10,115	34,121	6,915	4,572	55,723
Nonstocked	-	202	1,262	-	1,464
Total	576,314	341,225	195,386	113,291	1,226,216
Working Circle Totals					
Old growth sawtimber	650,184	430,934	496,114	244,576	1,821,809
Young growth sawtimber	901,878	436,475	186,870	168,689	1,693,913
Poletimber	96,574	187,762	78,012	14,152	376,500
Seedlings and saplings	28,803	157,795	59,792	39,012	285,402
Nonstocked	-	3,924	4,625	-	8,550
Total	1,677,440	1,216,890	825,413	466,429	4,186,173

Table 109. Number of growing stock trees per acre by diameter class and stand size class on commercial timberland, Working Circle 2.

Diameter Class	Stand Size Class					Overall Average
	Old Growth Sawtimber	Young Growth Sawtimber	Poletimber	Seedlings and Saplings	Nonstocked	
	-----average number of trees/acre-----					
1.0 - 2.9	123.45	50.16	114.48	198.03	5.54	110.26
3.0 - 4.9	43.53	59.29	164.26	102.18	-	81.51
5.0 - 6.9	36.36	44.99	155.43	27.00	3.61	57.24
7.0 - 8.9	28.60	35.93	94.74	9.27	1.65	37.78
9.0 - 10.9	24.94	24.64	28.41	5.63	1.51	20.69
11.0 - 12.9	15.79	15.06	7.49	3.70	0.76	11.11
13.0 - 14.9	8.06	10.30	2.38	2.81	-	6.49
15.0 - 16.9	6.63	5.33	0.98	1.46	1.40	3.96
17.0 - 18.9	3.96	2.80	0.41	0.73	0.50	2.16
19.0 - 20.9	2.54	1.60	0.24	0.42	-	1.30
21.0 - 22.9	1.90	0.74	0.27	0.34	-	0.84
23.0 - 24.9	0.96	0.51	0.11	0.23	-	0.48
25.0 - 26.9	0.70	0.29	0.09	0.06	-	0.30
27.0 - 28.9	0.31	0.16	0.06	0.04	-	0.15
29.0+	0.78	0.34	0.10	0.08	0.09	0.34
Total	298.51	252.14	569.45	351.98	15.06	334.61

Table 110. Number of softwood and hardwood trees on commercial timberland by tree class, salvable dead, and ownership group, Working Circle 2, (thousand trees).

Owner Group: State and Other Public

Tree Class	Species					
	Softwoods		Hardwoods		Total	
	# trees	%	# trees	%	# trees	%
	-----thousand trees-----					
Desirable	14,044	27.5	154	44.4	14,198	27.6
Acceptable	21,871	42.9	178	51.3	22,050	43.0
Sound Cull	12,522	24.6	-	-	12,522	24.4
Rotten Cull	76	0.1	14	4.0	90	0.2
Salvable Dead*	2,475	4.9	1	0.3	2,476	4.8
Total	50,989	100.0	347	100.0	51,336	100.0

Owner Group: Forest Industry

Desirable	70,728	31.6	360	51.4	71,088	31.7
Acceptable	101,958	45.5	334	47.6	102,292	45.5
Sound Cull	43,126	19.3	-	-	43,126	19.2
Rotten Cull	274	0.1	7	1.0	281	0.1
Salvable Dead*	7,840	3.5	-	-	7,840	3.5
Total	223,927	100.0	701	100.0	224,628	100.0

Owner Group: Other Private

Desirable	34,182	33.4	1,086	37.5	35,267	33.5
Acceptable	49,010	48.0	1,720	59.3	50,729	48.3
Sound Cull	15,446	15.1	-	-	15,446	14.7
Rotten Cull	111	0.1	85	2.9	197	0.2
Salvable Dead*	3,447	3.4	10	0.3	3,457	3.3
Total	102,196	100.0	2,900	100.0	105,096	100.0

Working Circle Totals

Desirable	118,954	31.5	1,600	40.5	120,554	31.6
Acceptable	172,840	45.8	2,232	56.5	175,071	45.9
Sound Cull	71,095	18.9	-	-	71,095	18.7
Rotten Cull	461	0.1	107	2.7	568	0.2
Salvable Dead*	13,762	3.7	11	0.3	13,772	3.6
Total	377,111	100.0	3,949	100.0	381,060	100.0

\*The number of salvable dead trees includes only those trees with a d.b.h. of 5 inches and larger. The number of live trees by tree class includes all trees 1.0 inches at d.b.h. and larger.

Table 111. Area of commercial timberland by salvable dead volume class and ownership group, Working Circle 2, (thousand acres).

Volume Class (Net cubic feet per acre)	Ownership Group			Total	Percentage of Total
	State and Other Public	Forest Industry	Other Private		
	-----thousand acres-----				
None	63.3	218.7	161.1	443.1	50.2
1 - 100	29.2	106.6	45.4	181.1	20.5
101 - 200	12.7	77.6	40.3	130.6	14.8
201 - 300	6.5	15.2	11.6	33.3	3.8
301 - 400	6.4	16.4	7.6	30.4	3.4
401 - 500	0.6	13.7	5.2	19.5	2.2
501 - 600	4.6	8.2	5.2	17.9	2.0
601 - 700	0.3	8.2	2.6	11.1	1.3
701 - 800	-	8.3	-	8.3	0.9
801 - 900	-	-	-	-	-
901 - 1000	-	-	-	-	-
1001 - 1100	-	-	-	-	-
1101 - 1200	1.3	2.7	-	4.1	0.5
1201 - 1300	-	-	-	-	-
1301 - 1400	-	-	-	-	-
1401 - 1500	-	2.7	-	2.7	0.3
1501 - 1600	-	-	-	-	-
1601 - 1700	-	-	-	-	-
1701 - 1800	1.3	-	-	1.3	0.1
1801+	-	-	-	-	-
Total	126.3	478.3	279.0	883.5	100.0

Table 112. Net volume of salvable dead on commercial timberland by ownership group and condition of dead, Working Circle 2, (thousand cubic feet).

Ownership	Condition of Dead			Total
	No defect	Defect--Mostly Physical	Defect--Mostly Rot	
	-----thousand cubic feet-----			
State and Other Public	5,959	1,905	5,813	13,677
Forest Industry	16,026	7,189	31,975	55,190
Other Private	5,898	4,815	9,044	19,758
Working Circle Total	27,882	13,909	46,833	88,625



Table 113. Net volume of salvable dead on commercial timberland by forest type and condition of dead class, Working Circle 2, (thousand cubic feet).

Condition of Dead Class

Forest Type	No Defect		Defect-- Mostly Physical		Defect-- Mostly Rot		Total
	Standing	Down	Standing	Down	Standing	Down	
	-----thousand cubic feet-----						
Douglas-fir	8,188	915	3,255	1,767	8,669	5,562	28,356
Ponderosa pine	2,226	-	1,332	-	1,448	1,106	6,112
Lodgepole pine	3,847	1,429	2,510	567	5,864	3,713	17,929
Western larch	2,445	295	292	465	2,500	476	6,472
Other softwood types	5,106	3,181	1,032	2,689	10,157	7,339	29,505
Hardwood types	<u>251</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>251</u>
Total	22,063	5,820	8,420	5,489	28,637	18,196	88,625

Table 114. Net volume of nonsalvable dead by diameter class and ownership group on commercial timberland, Working Circle 2, (thousand cubic feet).

Ownership Group

Diameter Class	State and	Forest	Other	Total
	Other Public	Industry	Private	
	-----	thousand	cubic feet-----	
5.0 - 6.9	603	800	449	1,851
7.0 - 8.9	543	1,280	639	2,461
9.0 - 10.9	344	1,220	216	1,780
11.0 - 12.9	320	1,157	372	1,849
13.0 - 14.9	129	1,796	368	2,294
15.0 - 16.9	290	1,571	354	2,215
17.0 - 18.9	200	929	195	1,324
19.0 - 20.9	178	1,022	667	1,867
21.0 - 22.9	320	988	209	1,517
23.0 - 24.9	310	1,134	235	1,679
25.0 - 26.9	104	665	332	1,101
27.0 - 28.9	224	744	355	1,323
29.0+	<u>267</u>	<u>1,868</u>	<u>805</u>	<u>2,941</u>
Total	3,832	15,174	5,194	24,200

Table 115. Net volume of salvable dead by diameter class and condition of dead class for commercial softwood species, Working Circle 2, (thousand cubic feet).

Douglas-Fir

Condition of Dead Class

Diameter Class	Defect--Mostly		Defect--Mostly	Total
	No Defect	Physical	Rot	
	-----thousand cubic feet-----			
5.0 - 6.9	2,151	422	2,460	5,034
7.0 - 8.9	2,538	389	1,785	4,712
9.0 - 10.9	716	949	2,137	3,802
11.0 - 12.9	1,210	368	234	1,811
13.0 - 14.9	809	200	1,119	2,128
15.0 - 16.9	436	374	772	1,582
17.0 - 18.9	-	60	938	998
19.0 - 20.9	-	-	101	101
21.0 - 22.9	-	166	892	1,057
23.0 - 24.9	-	-	963	963
25.0 - 26.9	-	303	275	578
27.0 - 28.9	-	-	679	679
29.0+	952	-	471	1,423
Total	8,813	3,232	12,826	24,870

Ponderosa Pine

Condition of Dead Class

Diameter Class	Defect--Mostly		Defect Mostly	Total
	No Defect	Physical	Rot	
	-----thousand cubic feet-----			
5.0 - 6.9	405	269	2	677
7.0 - 8.9	509	-	573	1,081
9.0 - 10.9	444	96	456	997
11.0 - 12.9	230	256	462	949
13.0 - 14.9	222	314	409	945
15.0 - 16.9	223	109	320	652
17.0 - 18.9	-	404	-	404
19.0 - 20.9	-	-	136	136
21.0 - 22.9	318	48	275	641
23.0 - 24.9	-	-	74	74
25.0 - 26.9	-	-	-	-
27.0 - 28.9	149	104	129	382
29.0+	-	-	577	577
Total	2,501	1,600	3,414	7,515

Table 115.  
(Page 2)

Lodgepole Pine

Condition of Dead Class

Diameter Class	No Defect	Defect--Mostly	Defect--Mostly	Total
		Physical	Rot	
		-----thousand cubic feet-----		
5.0 - 6.9	3,299	576	3,912	7,787
7.0 - 8.9	3,003	533	3,972	7,508
9.0 - 10.9	974	2,071	2,060	5,105
11.0 - 12.9	580	240	1,522	2,343
13.0 - 14.9	415	-	707	1,123
15.0 - 16.9	-	-	238	238
17.0 - 18.9	-	-	-	-
19.0 - 20.9	-	-	-	-
21.0 - 22.9	-	-	-	-
23.0 - 24.9	-	-	-	-
25.0 - 26.9	-	-	-	-
27.0 - 28.9	-	-	-	-
29.0+	-	-	-	-
	<u>8,271</u>	<u>3,420</u>	<u>12,412</u>	<u>24,103</u>

Western Larch

Condition of Dead Class

Diameter Class	No Defect	Defect--Mostly	Defect--Mostly	Total
		Physical	Rot	
		-----thousand cubic feet-----		
5.0 - 6.9	284	170	447	902
7.0 - 8.9	351	-	300	651
9.0 - 10.9	-	237	374	611
11.0 - 12.9	-	580	-	580
13.0 - 14.0	260	764	164	1,188
15.0 - 16.9	323	-	296	619
17.0 - 18.9	-	115	1,519	1,635
19.0 - 20.9	-	-	635	635
21.0 - 22.9	-	-	215	215
23.0 - 24.9	-	462	447	910
25.0 - 26.9	295	-	201	496
27.0 - 28.9	-	-	-	-
29.0+	-	-	1,213	1,213
Total	<u>1,512</u>	<u>2,329</u>	<u>5,810</u>	<u>9,652</u>

Table 115.  
(Page 3)

All Other Softwoods

Condition of Dead Class

Diameter Class	Defect--Mostly		Defect--Mostly	Total
	No Defect	Physical	Rot	
	-----thousand cubic feet-----			
5.0 - 6.9	1,904	489	1,137	3,530
7.0 - 8.9	1,759	167	1,893	3,820
9.0 - 10.9	908	366	2,350	3,625
11.0 - 12.9	925	565	2,244	3,734
13.0 - 14.9	184	197	397	778
15.0 - 16.9	-	-	673	673
17.0 - 18.9	406	266	647	1,319
19.0 - 20.9	-	-	511	511
21.0 - 22.9	-	251	568	818
23.0 - 24.9	-	-	231	231
25.0 - 26.9	-	-	186	186
27.0 - 28.9	405	-	211	616
29.0+	293	677	1,321	2,291
Total	6,784	2,978	12,371	22,134

Total For All Softwood

Condition of Dead Class

Diameter Class	Defect--Mostly		Defect--Mostly	
	No Defet	Physical	Rot	Total
	-----thousand cubic feet-----			
5.0 - 6.9	8,044	1,927	7,959	17,929
7.0 - 8.9	8,159	1,089	8,523	17,772
9.0 - 10.9	3,043	3,719	7,378	14,139
11.0 - 12.9	2,945	2,010	4,462	9,417
13.0 - 14.9	1,890	1,475	2,797	6,162
15.0 - 16.9	983	483	2,298	3,764
17.0 - 18.9	406	845	3,105	4,356
19.0 - 20.9	-	-	1,384	1,384
21.0 - 22.9	318	465	1,949	2,732
23.0 - 24.9	-	462	1,715	2,177
25.0 - 26.9	295	303	662	1,260
27.0 - 28.9	555	104	1,019	1,678
29.0+	1,245	677	3,582	5,504
Total	27,882	13,559	46,833	88,275

Table 116. Ratio of net board foot Scribner volume to net cubic foot volume by diameter class and softwood species, Working Circle 2.

Diameter Class	Species										Total Softwood Species
	Douglas- fir	Ponderosa pine	Lodgepole pine	Western larch	Subalpine fir	Spruce	Western redcedar	Whitebark pine	Grand fir	Western white pine	
9.0 - 10.9	2.8	2.0	3.4	3.3	3.2	3.5	3.0	3.6	3.0	-	2.9
11.0 - 12.9	3.9	3.5	4.8	4.1	4.2	4.5	3.9	4.7	3.8	4.4	4.0
13.0 - 14.9	4.3	4.2	4.9	4.7	4.4	4.6	3.9	4.7	4.2	-	4.4
15.0 - 16.9	4.6	4.7	4.9	4.9	4.5	4.6	3.8	-	4.6	4.8	4.7
17.0 - 18.9	4.8	4.9	4.9	5.1	4.6	4.6	3.7	4.8	4.4	-	4.8
19.0 - 20.9	4.9	5.1	4.8	5.2	4.8	4.6	3.7	-	4.2	-	4.9
21.0 - 22.9	5.0	5.2	4.9	5.4	4.9	4.8	3.8	-	4.2	-	5.1
23.0 - 24.9	5.1	5.2	-	5.5	4.9	5.0	3.7	-	4.2	-	5.2
25.0 - 26.9	5.1	5.2	-	5.6	5.0	5.1	3.8	-	4.1	5.2	5.2
27.0 - 28.9	5.2	5.4	-	5.6	5.1	5.2	3.9	-	-	-	5.4
29.0+	5.2	5.8	-	5.5	5.2	5.5	4.1	-	-	-	5.5
Total Sawtimber (All trees 9.0"+ d.b.h.)	4.1	4.3	4.1	4.9	4.1	4.7	3.7	4.3	3.9	4.7	4.3
Total Growing Stock (All trees 5.0"+ d.b.h.)	3.1	3.8	1.6	4.0	2.0	4.1	3.7	2.9	2.9	4.7	3.0

Table 117. Average d.b.h. age by diameter class, species group, and M.A.I. site class for growing stock trees on commercial timberland, Working Circle 2.

Species Group: Douglas-fir

Diameter Class	M.A.I. Site Class ----- (ft <sup>3</sup> /acre/year) -----					
	20-49		50-84		85+	
	Age	Range	Age	Range	Age	Range
1.0 - 2.9*	46	21- 80	47	21- 80	44	21- 70
3.0 - 4.9	55	21-100	57	21-140	52	31- 80
5.0 - 6.9	72	21-170	74	21-200	62	31-150
7.0 - 8.9	89	21-200	81	21-200	76	41-190
9.0 - 10.9	102	31-200	94	31-200	92	41-200
11.0 - 12.9	129	51-200	111	41-200	90	31-190
13.0 - 14.9	143	31-200	119	21-200	98	31-200
15.0 - 16.9	158	71-200	141	41-200	120	51-200
17.0 - 18.9	172	101-200	157	71-200	130	61-200
19.0 - 20.9	178	121-200	158	61-200	139	61-200
21.0 - 22.9	188	161-200**	162	61-200	144	71-200
23.0 - 24.9	162	91-200**	171	61-200	169	91-200
25.0 - 26.9	195	191-200**	169	81-200	184	131-200
27.0 - 28.9	195	191-200**	186	131-200**	187	141-200
29.0 - 30.9	-	-	195	191-200**	179	131-200**
31.0 - 32.9	-	-	195	191-200**	195	191-200
33.0 - 34.9	195	191-200**	195	191-200**	195	191-200**
35.0 - 36.9	-	-	-	-	195	191-200**
37.0 - 38.9	-	-	-	-	-	-
39.0+	-	-	-	-	195	191-200**

\*Ages recorded for the 2 inch diameter class are total tree ages. All other diameter classes have d.b.h. age recorded for them.

\*\*Indicates a very small sample is responsible for the estimates.



Table 117.

(Page 2)

Species Group: Lodgepole pine

Diameter Class	M.A.I. Site Class ----- (ft <sup>3</sup> /acre/year) -----					
	20-49		50-84		85+	
	Age	Range	Age	Range	Age	Range
1.0- 2.9*	45	11- 70	46	31- 70	43	31- 60
3.0- 4.9	53	11- 70	58	21- 90	48	31- 80
5.0- 6.9	93	41-170	68	31-150	57	31-130
7.0- 8.9	120	71-200	91	31-200	63	41-110
9.0-10.9	127	61-200	101	51-200	78	41-160
11.0-12.9	128	71-200	116	41-200	88	51-180
13.0-14.9	146	81-200	121	51-200	70	51-120
15.0-16.9	188	181-200**	175	161-200**	75	51-120
17.0-18.9	-	-	140	51-200	67	51-90**
19.0-20.9	-	-	75	71- 80**	65	61-70**
21.0-22.9	-	-	185	181-190**	-	-
23.0-24.9	-	-	-	-	-	-
25.0-26.9	-	-	-	-	-	-
27.0-28.9	-	-	-	-	-	-
29.0-30.9	-	-	-	-	-	-
31.0-32.9	-	-	-	-	-	-
33.0-34.9	-	-	-	-	-	-
35.0-36.9	-	-	-	-	-	-
37.0-38.9	-	-	-	-	-	-
39.0+	-	-	-	-	-	-

\*Ages recorded for the 2 inch diameter class are total tree ages. All other diameter classes have d.b.h. age recorded for them.

\*\*Indicates a very small sample is responsible for the estimates.

Table 117.

(Page 3)

Species group: western larch, ponderosa pine, western white pine

Diameter Class	M.A.I. Site Class ----- (ft <sup>3</sup> /acre/year) -----					
	20-49		50-84		85+	
	Age	Range	Age	Range	Age	Range
1.0- 2.9*	28	11- 40	36	11- 60	38	11-90
3.0- 4.9	45	21- 80	55	21- 90	40	21-60
5.0- 6.9	56	21-100	64	21-130	66	21-110
7.0- 8.9	70	21-150	72	21-150	63	31-140
9.0-10.9	95	31-200	79	21-200	71	31-170
11.0-12.9	143	31-200	86	31-200	71	31-200
13.0-14.9	132	71-200	104	41-200	77	41-200
15.0-16.9	158	81-200	120	41-200	89	41-200
17.0-18.9	171	101-200	137	41-200	103	41-200
19.0-20.9	169	81-200	158	61-200	101	51-200
21.0-22.9	188	151-200**	173	51-200	127	51-200
23.0-24.9	194	171-200**	177	71-200	130	51-200
25.0-26.9	195	191-200**	173	71-200	135	61-200
27.0-28.9	195	191-200**	186	91-200	158	71-200
29.0-30.9	195	191-200**	190	131-200**	121	61-200
31.0-32.9	195	191-200**	178	111-200**	164	81-200**
33.0-34.9	195	191-200**	195	191-200**	176	101-200**
35.0-36.9	195	191-200**	195	191-200**	195	191-200**
37.0-38.9	-	-	195	191-200**	195	191-200**
39.0+	-	-	195	191-200**	195	191-200**

\*Ages recorded for the 2 inch diameter class are total tree ages. All other diameter classes have d.b.h. age recorded for them.

\*\*Indicates a very small sample is responsible for the estimates.

Table 117.

(Page 4)

Species group: grand fir, subalpine fir, spruce, western redcedar, western hemlock, mountain hemlock

Diameter Class	M.A.I. Site Class (ft <sup>3</sup> /acre/year)					
	20-49		50-84		85+	
	Age	Range	Age	Range	Age	Range
1.0- 2.9*	62	31-100	53	31- 80	51	31-100
3.0- 4.9	79	41-140	66	31- 90	56	41- 80
5.0- 6.9	115	61-200	88	31-200	65	31-180
7.0- 8.9	130	61-200	100	41-200	92	31-190
9.0-10.9	144	51-200	99	31-200	99	41-200
11.0-12.9	125	121-130**	128	41-200	111	51-200
13.0-14.9	195	191-200**	128	51-200	122	51-200
15.0-16.9	-	-	141	61-200	141	51-200
17.0-18.9	-	-	132	71-200	147	61-200
19.0-20.9	-	-	158	131-180	151	71-200
21.0-22.9	-	-	155	151-160**	159	101-200
23.0-24.9	-	-	190	181-200**	165	81-200
25.0-26.9	-	-	195	191-200**	153	71-200
27.0-28.9	-	-	-	-	195	191-200**
29.0-30.9	-	-	-	-	180	151-200**
31.0-32.9	-	-	-	-	193	181-200**
33.0-34.9	-	-	-	-	155	151-160**
35.0-36.9	-	-	195	191-200**	192	181-200**
37.0-38.9	-	-	-	-	170	141-200**
39.0+	-	-	-	-	182	141-200**

\*Ages recorded for the 2 inch diameter class are total tree ages. All other diameter classes have d.b.h. age recorded for them.

\*\*Indicates a very small sample is responsible for the estimates.

Table 118. Area of commercial timberland by crown density, condition class, and climax series, Working Circle 2, (thousand acres).

Crown Density 0-30	Ponderosa pine	Douglas fir	Spruce	Climax Series				Total
				Grand fir	Western redcedar	Subalpine fir	Hardwood Climax	
Condition Class	-----thousand acres-----							
Excellent	-	39.7	1.2	-	-	8.1	-	49.1
Good	12.1	77.5	-	-	-	20.5	3.2	113.3
Fair	4.8	29.4	-	1.6	-	4.0	0.7	40.6
Poor	3.2	5.4	-	-	-	-	-	8.6
Total	20.1	152.0	1.2	1.6	-	32.6	4.0	211.6
Crown Density 31-50								
Condition Class								
Excellent	-	60.2	-	2.7	-	16.5	-	79.4
Good	3.8	83.9	8.6	2.5	-	6.0	0.6	105.4
Fair	5.8	19.9	-	-	-	5.4	0.7	31.9
Poor	-	-	-	-	-	-	-	-
Total	9.6	163.9	8.6	5.2	-	28.0	1.3	216.7
Crown Density 51-70								
Condition Class								
Excellent	-	106.6	11.3	5.5	-	22.4	-	145.8
Good	4.2	55.2	5.5	-	5.5	27.5	-	97.8
Fair	8.4	6.5	2.9	-	-	10.9	1.6	30.4
Poor	-	2.9	-	-	-	3.3	-	6.2
Total	12.7	171.2	19.7	5.5	5.5	64.1	1.6	280.3
Crown Density 71+	-	61.7	5.8	25.9	13.9	64.4	3.2	175.0
Totals For All Crown Densities								
Condition Class								
Excellent	-	206.5	12.6	8.2	-	47.1	-	274.3
Good	20.2	216.6	14.0	2.5	5.5	54.0	3.8	316.5
Fair	19.1	55.9	2.9	1.6	-	20.3	3.1	102.8
Poor	3.2	8.3	-	-	-	3.3	-	14.8
71+ Crown Density	-	61.7	5.8	25.9	13.9	64.4	3.2	175.0
Total	42.5	548.9	35.3	38.2	19.4	189.1	10.2	883.5

Table 119. Available animal unit months (AUM's) on commercial timberland by crown density, condition class, and climax series, Working Circle 2.

Crown Density	Condition Class	Climax Series							Total
		Ponderosa pine	Douglas-fir	Spruce	Grand fir	Western redcedar	Subalpine fir	Hardwood Climax	
		-----AUM's-----							
0-30	Excellent	-	8,394	530	-	-	3,089	-	12,013
	Good	1,698	10,135	-	-	-	4,996	901	17,729
	Fair	970	4,012	-	218	-	340	174	5,714
	Poor	371	820	-	-	-	-	-	1,192
	Total	3,039	23,360	530	218	-	8,425	1,075	36,647
31-50	Excellent	-	10,096	-	137	-	2,048	-	12,281
	Good	474	9,336	1,114	83	-	529	138	11,673
	Fair	518	2,391	-	-	-	487	109	3,505
	Poor	-	-	-	-	-	-	-	-
	Total	992	21,823	1,114	220	-	3,064	247	27,459
51-70	Excellent	-	10,812	1,033	144	-	1,664	-	13,653
	Good	318	3,580	386	-	508	1,603	-	6,394
	Fair	691	158	144	-	-	225	614	1,832
	Poor	-	510	-	-	-	115	-	626
	Total	1,010	15,060	1,563	144	508	3,607	614	22,505

Totals For All Crown Densities\*

Condition Class	Ponderosa pine	Douglas-fir	Spruce	Grand fir	Western redcedar	Subalpine fir	Hardwood Climax	Total
Excellent	-	29,302	1,563	281	-	6,801	-	37,947
Good	2,490	23,050	1,500	83	508	7,128	1,039	35,796
Fair	2,180	6,556	144	218	-	1,052	897	11,051
Poor	371	1,331	-	-	508	115	-	1,817
Total	5,041	60,239	3,206	581	508	15,096	1,936	86,611

\*No range data was collected on forest land with greater than 70% crown density because the range is considered to have no value for livestock.

Table 120. Potential animal unit months (AUM's) by crown density and climax series, Working Circle 2.  
Climax Series

Crown Density	AUM's							Total
	Ponderosa pine	Douglas fir	Spruce	Grand fir	Western redcedar	Subalpine fir	Hardwood Climax	
0 - 30	5,785	33,815	530	509	-	11,469	1,552	53,659
31 - 50	2,074	30,897	2,159	302	-	4,066	383	39,881
51 - 70	1,899	17,072	1,896	144	762	4,310	307	26,389
71+	-	-	-	-	-	-	-	-
Total	9,758	81,784	4,585	955	762	19,845	2,242	119,929



# APPENDIX 4. WOOD PROCESSORS IN WORKING CIRCLE 2.

Table 121. Sawmills in Working Circle 2.

<u>COMPANY</u>	<u>ANNUAL PRODUCTION</u>	<u>SPECIES PROCESSED</u>	<u>PRODUCTS MANUFACTURED</u>
MINERAL COUNTY			
<u>St. Regis</u>			
Northwestern Cedar	3-5 MMBF	WRC	Dimension
Dimension		DF	1" Boards
		PP	Timbers
		LPP, ES	Rough and Surfaced
Timber Utilization Inc.			
<u>Superior</u>	Greater than	DF	Dimension
Diamond	50 MMBF	ES	1" Boards
International Corp.		WH	Rough and
		WP,WL,LPP,	Surfaced
		PP,WRC,WF	
James Mead			
MISSOULA COUNTY			
<u>Bonner</u>			
Champion Building	Greater than	DF,ES,WL,LPP,	Dimension
Products	50 MMBF	PP,WF,WH,WRC	1" Boards
			Ties, Studs,
			Timbers
<u>Clinton</u>			
Terry Montelius			
Dave Sheets			
<u>Greenough</u>			
K & L Mills	10-25 MMBF	LPP	Dimension, Timbers, Houselogs, Posts, Rails
<u>Huson</u>			
Thisted Ranch	Less than 3 MMBF		Dimension, 1" Boards, Timbers, Rough
<u>Lolo</u>			
Jack Bailly	Less than 3 MMBF		Dimension, 1" Boards Timbers, Rough
Bud Brooks	Less than 3 MMBF		Dimension, 1" Boards, Timbers, Rough

<u>Missoula</u> Champion Building Products	Greater than 50 MMBF	DF,ES,WP, WL,LPP,PP	Studs, Ties, Surfaced Dry, Surfaced Green
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Ken Matheny

Missoula White Pine Sash	10-25 MMBF	PP	Dimension 1" Boards Cut, Stock
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Rausch Logging	Less than 3 MMBF		
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<u>Seeley Lake</u> Pyramid Mountain Lumber Company	10-25 MMBF	DF,ES,WL, PP,LPP,WF	Dimension, Timbers, Ties, Studs, Houselogs
--	------------	------------------------	---

#### RAVALLI COUNTY

Corvallis  
Frank Serro

<u>Darby</u> Champion Building Products	Greater than 50 MMBF	LPP,PP,WF, ES,DF,WL	Studs
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Don Leavens	Less than 3 MMBF		Part-time Sawmill
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Robert Parmenter	5-10 MMBF		Dimension 1" Boards Surfaced
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Stoltze-Conner Lumber Company	10-25 MMBF	DF,ES,LPP, WF,PP	Dimension 1" Boards Surfaced
----------------------------------	------------	---------------------	------------------------------------

<u>Florence</u> S and D Houselogs	Less than 3 MMBF		Rough
--------------------------------------	---------------------	--	-------

<u>Hamilton</u> Ted Finley Sawmill	Less than 3 MMBF	DF,PP	Dimension 1" Boards Studs, Rough
---------------------------------------	---------------------	-------	---

McGinnes Wood Products	Less than 3 MMBF	DF,PP	1" Boards, Rough
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Ralph Springer

<u>Stevensville</u> Cody F. Lunceford	Less than 3 MMBF		Portable Sawmill
<u>Victor</u> Dunbar Sawmill	Less than 3 MMBF	DF,PP	Dimension 1" Boards Surfaced

Table 122. Post and pole processors in Working Circle 2.

<u>COMPANY</u>	<u>PROCESS USED</u>	<u>PRESERVATIVE USED</u>	<u>PRODUCTS MANUFACTURED</u>
MISSOULA COUNTY			
<u>Evaro</u> J & N Post and	thermal-non pressure	Penta-oil born	Posts, Poles
<u>Huson</u> David R. Guelff	thermal-non pressure	Penta-oil born	Posts, Poles Rails
<u>Seeley Lake</u> Pyramid Mountain Lumber Company			
RAVALLI COUNTY			
<u>Hamilton</u> Cooper Post and Pole Plant	cold soak-non pressure	Penta-oil born	Posts, Poles
Porterbilt Post and Pole			
<u>Stevensville</u> McPherson	cold-soak-non pressure	Penta-oil born	Posts, Poles
Stevensville Post and Pole	cold-soak-non pressure	Penta-oil born	Posts, Poles

Table 123. Plywood and particle board processors in Working Circle 2.

<u>COMPANY</u>	<u>CAPACITY</u>	<u>PRODUCT MANUFACTURED</u>
MISSOULA COUNTY		
<u>Bonner</u> Champion Building Products	300MM sq. ft. 3/8"	Softwood plywood
<u>Missoula</u> Louisiana Pacific	100MM sq. t. 3/4"	Mat formed particle board

Table 124. Log home manufacturers in Working Circle 2.

<u>COMPANY</u>	<u>AVERAGE NUMBER OF HOMES ANNUALLY</u>	<u>SPECIES PROCESSED</u>	<u>TYPE OF LOG HOME</u>
MINERAL COUNTY			
<u>St. Regis</u> Timber Utilization Inc.	NA		
MISSOULA COUNTY			
<u>Condon</u> Rustics of Lindburgh Lake	150	Green LPP	Hand peeled and notched
<u>Lolo</u> Lolo Creek Log Homes	NA		
<u>Missoula</u> Real Log Homes	500	LPP,PP	Two sided log cants, 6" depth, 8"-12" width
RAVALLI COUNTY			
<u>Corvallis</u> Frontier Homes	NA		
<u>Darby</u> Intermountain Log Homes, Inc.	80	Dry LPP	Turned Logs
Master Log Homes	NA		
<u>Florence</u> S and D Houselogs, Inc.	NA		Lathe Turned
<u>Hamilton</u> Boyne Falls Log Homes	NA		
Log Homes and Wood Products	35	Dead LPP	Milled Logs
Mountain Logs	35	LPP,WP,ES,WL	Hand peeled and notched
Rocky Mountain Log Homes	300	Dead LPP, WWP	Lathe turned houselogs and rough sawn square timbers

Stevensville

Custom Log Homes

80

Dead LPP

Hand fitted

Victor

Alpine Log Homes

NA

Dead LPP

Handcrafted  
undimensional  
logsMountain Meadow  
Lodges

NA

## APPENDIX 5. DESCRIPTION OF TREATMENT CODES

The purpose of this appendix is to define the stand characteristics which make up each of the fourteen categories. In many cases, a stand may receive more than one treatment code. Under each treatment code description below there is a list of the other codes which may occur in combination with the one being described.

### Code 10: Harvest--high risk

Code 10 includes all commercial, non-vigorous, overmature stands, as well as any merchantable stand which exhibits an unmanageable insect or disease problem.

Lodgepole sawtimber stands which are over 100 years old are automatically included.

Possible combinations: None

### Code 11: Harvest--low risk

This is a diverse category which includes the following types of stands:

1. All commercial stands older than 100 years which do not qualify as high risk (they are of relatively better vigor than high risk stands). If such a stand is dominated by shade tolerant species, it is included here, regardless of age.
2. All commercial lodgepole stands which are 50-100 years old and non-vigorous, and which have not qualified as high risk.
3. Various other stands containing commercial material which are not manageable because of poor tree quality and vigor.

Possible combinations: None

### Code 12: Commercial thinning

This category includes stands which are fully stocked to overstocked with Douglas-fir, western larch, ponderosa or lodgepole pine, and which meet all of the following characteristics:

1. Would yield commercial sawtimber if thinned.
2. Are less than 100 years old.
3. Are currently growing at less than full potential, but are capable of release.
4. Do not exhibit unmanageable insect or disease problems.

Possible combinations: (12, 13), (12, 13, 22), (12, 22).



### Code 13: Overstory removal

Code 13 includes any stand which contains commercial size trees in excess of 1,000 b.f. per acre, and which also meets one of the following conditions:

The trees in question are relicts, i.e., not part of the manageable stand component.

The trees in question represent the upper story of a two storied stand, but they are inadequately stocked to be treated as a separate management component.

Possible combinations: (13, 22, 33), (12, 13), (12, 13, 22), (13, 33), (13, 22), (13, 22, 23), (13, 20), (13, 20, 23), (13, 20, 22, 23), (13, 23), (13, 21).

### Code 14: Two storied stand. Overstory: Harvest--high risk Understory: Manageable

This category is made up of two storied sawtimber stands meeting the requirements of treatment code 10. The following conditions also exist:

1. The overstory has a crown density of 10 - 50%.
2. One or more of the following treatment codes is indicated for the understory: 12, 20, 22, 30, or 33.

### Code 15: Two storied stand. Overstory: Harvest--low risk Understory: Manageable

Two storied sawtimber stands meeting the requirements of treatment code 11, plus the following conditions, are assigned this code:

1. The overstory has a crown density of 10-50%.
2. One or more of the following treatment codes is indicated for the understory: 12, 20, 22, 30, or 33.

### Code 20: Precommercial thinning

There are two general types of stands which qualify for precommercial thinning. These are:

1. Seedling and/or sapling stands which contain a manageable component of desirable or acceptable crop trees, but which will suffer growth loss from competition prior to reaching merchantable size, if stocking is not reduced.
2. Sapling to pole size Douglas-fir, western larch, ponderosa or lodgepole pine which meet all of the following characteristics:
  - a. Stand is currently growing at less than full potential because of competition.

- b. There is a fully stocked, manageable component which is capable of release.
- c. Thinning would not yield merchantable material, and would not involve the felling of near-merchantable trees.

Possible combinations: (13, 20), (13, 20, 23), (20, 23), (13, 20, 22, 23), (20, 22, 23), (13, 20, 22), (20, 22).

#### Code 21: Stand conversion

This treatment code automatically implies the need for regeneration, following conversion.

Stands which qualify for this category include all precommercial stands which have unmanageable insect or disease problems. Also included are non-vigorous precommercial stands which would not be capable of release, if thinned. In the case of lodgepole pine, it includes all non-vigorous stands which are older than 50 years.

Seedling and sapling stands which are grossly understocked with crop trees, but which contain a significant stocking of undesirable (excess) trees, are also included under this category.

Possible combinations: (13, 21).

#### Code 22: Sanitation

This code applies to all crop stands whose health can be improved through intermediate cuttings, i.e., cuttings which reduce the source of the insect or disease problem (not applicable for most defoliating insect problems).

This category does not include stands which are in need of commercial harvest or precommercial stand conversion because of insects or disease, low vigor, or stagnation. It applies only to stands which can be sanitized and managed as a crop stand.

Possible combinations: (13, 22, 33), (22, 33), (12, 13, 22), (12, 22), (13, 22), (13, 22, 23), (22, 23), (13, 20, 22), (20, 22), (13, 20, 22, 23), (20, 22, 23).

#### Code 23: Regeneration of understocked areas

Code 23 includes all precommercial stands which are inadequately stocked with desirable or acceptable crop trees. The minimum standard for adequate crop tree stocking is 210 trees per acre, with at least 70% of the area stocked.

This code by no means implies a particular method of regenerating understocked areas. Under code 23, options may exist for use of existing seed sources, site preparation, planting, direct seeding, or combinations of these methods. In many cases, this treatment code represents situations where the stocking of undesirable excess trees must be reduced prior to supplementing the existing understocked crop stand with additional regeneration. In such cases, this treatment would occur in combination with precommercial thinning (code 20).

It should also be noted that regeneration needs which are associated with

stand conversion (code 21) are separate from those under code 23.

Possible combinations: (13, 22, 23), (22, 23), (13, 20, 23), (20, 23), (13, 20, 22, 23), (20, 22, 23), (13, 23).

Code 30: No treatment due to productive condition

Stands in this category are adequately stocked with productive crop trees, for timber management purposes. In the case of very young stands, stocking of undesirable (excess) competition is minimal, and should not impact growth rates on crop trees before merchantable size is attained. In the case of large sapling to small sawtimber stands, the crop trees are currently growing at or near full potential for their age and the site, and are expected to continue to do so for several years.

There are no significant insect or disease problems associated with stands in this category, with the possible exception of defoliators which have not affected the manageability of the stand.

Possible combinations: None

Code 32: No treatment--Inoperable

This category includes all stands on sites which are considered inoperable, using current, conventional Montana logging systems (balloon and helicopter systems are not considered conventional in Montana).

Generally, slopes steeper than 80% are considered inoperable at the present time. Other inoperable situations include very rocky areas, where road building and logging might be difficult, or an otherwise operable site which has no operable access routes.

This code is not assigned using the key, but is based on field observations.

Code 33: No treatment--Defer until merchantable

Code 33 includes poletimber to small sawtimber size stands of trees whose growth rates could be improved through thinning, but not without the loss of near-merchantable material. Because growth rates and tree quality are acceptable (but not optimal), stands in this category are deferred from treatment until the stand emerges into a size class where commercial treatment options exist. However, stands in this category may qualify for overstory removal (code 13) and/or sanitation (code 22), even though the crop stand has been deferred from thinning. In other words, the "No treatment" label applies only to the main stand component.

Possible combinations: (13, 22, 33), (22, 33), (13, 33).

Code 40: Unknown - Poor crowns, good growth

This is a fairly unique but well defined category for which the data compiled in the stand treatment analysis does not provide enough information to make a logical decision.

All stands under code 40 possess the following characteristics:

1. Fully stocked Douglas-fir, western larch, or ponderosa pine

saplings, poles, or small sawtimber.

2. Growth rates at or near full potential.
3. Poor crown ratios (less than 30%).
4. No unmanageable insect or disease problems.

The problem in this situation is that the compiled data fails to explain why a stand would have poor crown ratios, but also good growth rates during the last ten (10) years. Have crowns recently become suppressed from competition? In this case, the next ten years' growth might be much lower. Or, has this stand been released during the last ten years? In this case, the crown ratios may be improving, even though they are presently unacceptable.

Because the data summary does not answer the above questions, the treatment opportunities are not logically defined for such a stand.

Possible combinations: None



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# APPENDIX 7. FOREST LAND GRAZING DATA SHEET AND SAMPLE SCS GRAZING GUIDE

## MONTANA DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION DIVISION OF FORESTRY

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### WOODLAND RANGE FORAGE CONDITION RECORD

Location 372 Crew HAINAH - LONG  
County 63 Date 8/21/79  
Working Circle 2 State Forest

Species	Column A Present Percent Composition by Wt.	Column B Present Percent Composition Allowed
DECREASERS:		
BLUEBUNCH WEEDGRASS	30	30
SERVICEBERRY	5	5
ELK SEDGE	15	15
INCREASERS:		
SAUSANAPOOT	5	5
IDAHO FESCUE	20	15
LUPINE	5	5
POKE WIC	5	5
WOOD WIC (SILVERHAWK)	10	5
ARKER	7	
INVADERS:		
KNAPOWEED	5	

Percent Composition 100% 85%  
Condition Class Rating XXXX EXCEL. Condition

Guide Sheet DOUG FIR Precipitation Zone

Crown Density 10-30 30-50 50-70 70+  
Soil Depth Deep and Moderately Deep (20") Shallow and Coarse  
Very Shallow (10")

Greater Effective Moisture YES NO

REMARKS: .4 AUM'S GRAZABILITY FACTOR OF ABOUT 12% DUE TO 74% COVER (20%)

PART I. GUIDE FOR DETERMINING FORAGE CONDITION - 15 to 19 INCH PRECIPITATION ZONE

DECREASERS	INCREASESERS	Maximum Percent Dry Weight Produced Annually-Little or No Grazing						INVADEERS
		Deep & Moderately Deep Soils (Over 20")			Shallow & Coarse Upland Soils			
		Tree Crown Cover Percent			Tree Crown Cover Percent			
		10-30	30-50	50-70	10-30	30-50	50-70	
Richardson's needlegress	Pinegrass	5	10	20	5	10	15	All annuals
Blue wildrye	Prairie junegrass	5	-	-	5	-	-	Goatweed
Rough fescue	Idaho fescue	10	5	-	15	5	-	Cheatgrass brome
Columbia needlegress	Carex Spp.	10	15	20	-	10	15	Spotted knapweed
Mountain brome	Heartleaf arnica	-	5	10	-	10	15	Dandelion
Nodding brome	Balsamroot	5	-	-	5	-	-	Kentucky bluegrass
Bluebunch wheatgrass	Lupine	5	-	-	5	-	-	Canada bluegrass
Bearded wheatgrass	Other forb increasers	10	15	15	5	10	10	Timothy
Western wheatgrass	Oregon grape	-	5	5	-	5	10	Thistles
Slender wheatgrass	Bearberry	-	5	5	-	5	10	Mullein
Sticky geranium	Other woody increasers	-	5	10	-	-	-	Leafy spurge
Stoneseed								Dalmation toadflax
Serviceberry								Houndstongue
Snowberry								Star thistle
Huckleberry *								
Chokecherry								

Note: Tree Crown Coverage percent can be estimated from aerial photos using  
Crown Coverage Scale. (Handbook page W-132)  
\* Decreaser with game use.

PART II. GUIDE FOR MAKING RECOMMENDATIONS ON STOCKING

Average Annual Precipitation Inches	PRESENT FORAGE VALUE IN PERCENT OF POTENTIAL														
	75%						50%						25%		
	EXCELLENT			GOOD			FAIR						POOR		
	Crown Cover Percent 10-30	30-50	50-70	Crown Cover Percent 10-30	30-50	50-70	Crown Cover Percent 10-30	30-50	50-70	Crown Cover Percent 10-30	30-50	50-70	Crown Cover Percent 10-30	30-50	50-70
	(Animal Unit Months Per Acre)														
25-29	.70	.45	.25	.60	.40	.25	.40	.25	.20	.20	.10	.10	.10	.10	.10
20-24	.55	.30	.15	.45	.25	.15	.35	.20	.16	.15	.05	.05	.15	.05	.05
15-19	.40	.20	.10	.35	.15	.10	.25	.15	.05	.10	.05	.05	.10	.05	-
10-14	.25	.10	.05	.20	.10	.05	.10	.05	-	.05	.05	0	.05	0	-
Areas with above normal effective moisture use $\frac{1}{2}$ to 1 zone higher than precipitation zone where located.															
For SHALLOW SOILS use values one half zone lower than precipitation zone where located.															
For VERY SHALLOW SOILS use values one zone lower than precipitation zone where located.															
All utilization cuts due to adverse accessibility are to be applied to grazing unit after AUM's are summarized.															

Areas with above normal effective moisture use  $\frac{1}{2}$  to 1 zone higher than precipitation zone where located.  
For SHALLOW SOILS use values one half zone lower than precipitation zone where located.  
For VERY SHALLOW SOILS use values one zone lower than precipitation zone where located.  
All utilization cuts due to adverse accessibility are to be applied to grazing unit after AUM's are summarized.

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## GLOSSARY

### Acceptable tree

Growing-stock tree of commercial species that does not qualify as a desirable tree.

### Access

The degree to which the range will be utilized. The factors affecting grazability are slope, miles to the nearest stream, trails and roads in the area, water developments, brush, slash, rocks and mechanical barriers.

### Accretion

Annual increase in net volume of trees in a size class, and the increase in net volume of trees after reaching a measured size class during the year.

### Allowable cut

The volume of timber that would be cut on commercial forest land during a given period under specified management plans for sustained production such as those in effect on national forests.

### Animal Unit

One mature (1,000 pound) cow with or without an unweaned calf, or the equivalent. A mature bull is 1.3 animal units, a mature horse is 1.25 animal units, a mature sheep is 0.2 of an animal unit, a mature elk is 0.7 of an animal unit, and a mature deer is 0.2 of an animal unit.

### Animal unit month

The amount of forage required by an animal unit for one month.

### Area-condition class

A classification of commercial forest land based upon stocking by desirable trees and other conditions affecting current and prospective timber growth.

### Basal area

A measure of square feet of space occupied by the stem of a tree. This measurement is made at breast height.

### Basal area factor

The basal or stem area per unit of stand area for a given angle for each tree intercepted from a given point.

### Basal area standard

Sixty percent of normal basal area usually for trees 0.6 inches d.b.h. and larger.

### Bureau of Land Management lands

Federal land administered by the USDI Bureau of Land Management.

### Census water

Water areas of more than 40 acres and water courses more than 1/8 mile wide.

Climax series

A group of habitat types that at climax will be dominated by the same tree species.

Commercial species

Tree species presently or prospectively suitable for industrial wood products.

Commercial thinning

A thinning in which the cut trees are large enough to be removed and utilized, regardless of whether their sale offsets the cost of the thinning.

Commercial timberland

Forest land producing or capable of producing crops of industrial wood and not withdrawn from timber utilization. (Note: Areas qualifying as productive forest land have the capability of producing in excess of 20 ft<sup>3</sup>/acre/year of industrial wood under management. Currently inaccessible and inoperable areas are included, except where the areas involved are small and unlikely to become suitable for production of industrial wood in the foreseeable future).

Condition class

A method of expressing the general health of the range by comparing the expected percentage of the climax composition contributed by each species to the actual composition. No invaders (plants present only because of a disturbance, such as grazing) are counted and only the amount of increasers (plants that increase under grazing pressure) that would be present at climax are included. All of the decreasers (plants that decrease under grazing pressure) are counted.

County and municipal lands

Lands owned by counties and local public agencies or municipalities, or lands leased to these governmental units for 50 years or more.

Crown class

A classification of trees based on dominance in relation to adjacent trees in the stand as indicated by crown development and amount of light received from above and the sides.

Crown density

The percentage of the forest floor that is covered by tree crowns. Forest land with greater than 70% crown density is considered to have no range value for livestock.

Cull

Portions of a tree that are unusable for industrial wood products because of rot, form, or other defect.

Decreaser (decreasing range plant)

Plants which decrease under heavy grazing pressure. These are usually the more palatable plants and the ones that the livestock prefer to eat.



#### Diameter breast height (d.b.h.)

The diameter of a tree at a point  $4\frac{1}{2}$  feet above the ground on the tree's uphill side. Height of d.b.h. may vary on abnormally formed trees.

#### Desirable tree

Live noncull trees of commercial species are divided into two classes: desirable and acceptable. For a tree to be desirable it must be free from disease, of good form, potentially not more than 10 percent defect of disease or fire scar, of good vigor, and not excessively limby if sawtimber. A tree will be considered to have good vigor if it has 40 percent or more crown (exception: ponderosa pine, and aspen may have only 30 percent crown to be classed as desirable). It is the kind of tree that would be favored in cultural operations or featured in management in under rotation-age stands. Mature trees (over rotation age) of commercial size with less than 20 percent defect and expected to live 10 years are low-risk trees and may also be classed as desirable trees. A species which is not adapted to the site should be classified as sound cull.

#### Diameter Classes

A classification of trees based on diameter outside bark, measured at breast height ( $4\frac{1}{2}$  feet above the ground). Note: D.b.h. is the common abbreviation for diameter at breast height. Two-inch diameter classes are commonly used in Forest Survey, with the even inch of the approximate midpoint for a class. For example, the 6-inch class includes trees 5.0 through 6.9 inches d.b.h., inclusive).

#### Farmer-rancher lands

Lands owned by individuals with a minimum of 40 acres.

#### Fixed radius plot

For this inventory a  $1/300$  acre (6.8 feet radius), circular plot, located at each sample point on which live trees up to 4.99 inches d.b.h. are tallied.

#### Forest industry

Lands owned by companies or individuals operating wood-using plants.

#### Forest land

Land at least 16.7 percent stocked by forest trees, or formerly having such tree cover, and not currently developed for nonforest use. Forest land does not include land currently developed for nonforest uses such as urban or thickly settled residential or resort areas, city parks, orchards, improved roads, or pasture lands improved by such measures as seeding or irrigation. The minimum area for classification of forest land is one acre. Roadside, streamside, and shelterbelt strips of timber must be at least 120 feet wide to qualify as forest land. Unimproved roads, trails, streams, and clearings in forest areas are classed as forest land if they are less than 120 feet wide.

#### Forest types

A classification of forest land based upon the dominant species forming a plurality of stocking based on area occupied in the present tree cover.



## Fish, Wildlife, and Park Land

Land administered by the Montana Department of Fish, Wildlife, and Parks.

## Grazability

The degree to which the range will be utilized. The factors affecting grazability are slope, miles to the nearest stream, trails and roads in the area, water developments, brush, slash, rocks and mechanical barriers.

## Gross growth

Annual increase in net volume of trees in the absence of cutting and mortality. It includes ingrowth and accretion.

## Growing-stock trees

Live trees of commercial species qualifying as desirable or acceptable trees. (Excludes rough, rotten, and dead trees.)

## Growing stock volume

Net volume in cubic feet of live sawtimber trees and live poletimber trees (all trees 5.0 inches d.b.h. and larger) from stump to a minimum 4.0 inch top (of central stem) outside bark. Net volume equals gross volume less deduction for rot and missing bole sections.

## Habitat type

An aggregation of all land areas potentially capable of producing similar plant communities at climax.

## Hardwoods

Dicotyledonous trees, usually board-leaved and deciduous.

## Increaser (increasing range plant)

Plants which increase under heavy grazing pressure. These are usually less palatable plants.

## Indian lands

Tribal lands held in fee by the Federal Government, but administered for Indian tribal groups and Indian trust allotments.

## Ingrowth

The number or net volume of trees that grow large enough during a specified year to qualify as saplings, pole timber, or sawtimber. The measurement is at the size of entry into the size class.

## Inoperable stand

Any stand on a site that is considered inoperable using current, conventional Montana logging systems (balloon and helicopter systems are not considered conventional in Montana). A more detailed explanation is given under treatment code 32 in Appendix 5.

## Invader (invading range plant)

Plants that are not part of the climax cover but which invade under heavy grazing pressure. Few invaders are preferred by livestock and many are worthless.

Land use influence zones

Zones delineated around areas or regions where it is likely that other nontimber uses or environmental constraints would have an impact on availability of timber.

Mean annual increment

A measure of the volume of wood, in cubic feet, produced on 1 acre during 1 year. Forest Survey minimum standard for commercial forest land is the ability to produce 20 ft<sup>3</sup>/acre/year.

Miscellaneous federal

Federal lands other than national forest lands, lands administered by the USDI Bureau of Land Management, or Indian lands.

Mortality

Number of sound-wood volume of growing stock trees dying from natural causes during a specified period.

Mortality tree

A tree of commercial species, 5.0 inches d.b.h., or larger standing or down, that has died within the past 5 years and was not a cull tree at the time of death.

National forest land

Federal lands which have been designated by executive order or statute as national forests or purchase units and other lands under the administration of the USDA Forest Service, including experimental areas.

Net annual growth

The increase in net volume of a specified size class for a specific year. (Note: Components of net annual growth include the increment in net volume of trees at the beginning of the specific year surviving to its end, plus net volume of trees reaching the size class during the year, minus the net volume of trees that died during the year, minus the net volume of trees that became rough or rotten trees during the year). Net growth figures in this publication when expressed as ft<sup>3</sup>/acre/year of growing stock are for all live growing stock trees 5.0 inches d.b.h. and larger.

Net volume

The gross volume of a tree less deductions for rot, sweep, or other defect affecting use for wood products.

Noncommercial forest land

Forest land incapable of producing 20 cubic feet per acre of industrial wood under management, because of adverse site conditions, includes only nonreserved forest land.

Noncommercial species

Tree species of typically small size, poor form, or inferior quality which normally do not develop into trees suitable for industrial wood products.

#### Nonforest land

Land that has never supported forests and lands formerly forested where use for timber management is precluded by development for other uses. It includes areas used for crops, improved pasture, residential areas, city parks, improved roads of any width and adjoining clearings, powerline clearings of any width and 1 to 40 acres of water classified by the Bureau of the Census as land. If intermingled in forest areas, unimproved roads and nonforest strips must be more than 120 feet wide, and clearings, etc., more than 1 acre in size to qualify as nonforest land.

#### Nonsalvable dead

Dead trees 5.0 inches d.b.h. and larger, standing and down, and less than 50 percent sound on a cubic-foot basis.

**Firm rotten** Tree is less than 50 percent sound on a cubic-foot basis. More than half the total volume loss is due to rot and less than half is due to such defects as excessive sweep and crook. Tree or potential product sections are firm enough to hold together if handled.

**Crumbly rotten** Tree is less than 50 percent sound on a cubic-foot basis. More than half the total volume loss is due to rot and less than half is due to such defects as excessive sweep and crook. Tree or potential product sections will not hold together if handled.

#### Nonstockable

Areas of forest land not capable of supporting seedlings of commercial species because of the presence of rock, water, roads, etc.

#### Nonstocked land

Commercial forest land less than 16.7 percent stocked with growing stock trees.

#### Normal basal area

The basal area at which all growing space is effectively occupied but having ample room for development of the crop trees.

#### Old-growth sawtimber stands

Sawtimber stands in which 50 percent or more of the area is occupied by old-growth sawtimber trees.

#### Other forest land

See noncommercial forest land

#### Other private ownership group

The ownership group that consists of land owned by farmers, ranchers, miscellaneous private corporations, and miscellaneous private individuals..

#### Other private corporate

Land owned by corporations not in the forest industry.

#### Other private individual

Lands smaller than 40 acres owned by individuals.

#### Other state lands

State land other than state forests, land board, and Fish, Wildlife, and Parks.

#### Ownership class

The finest level of ownership used in this report. The classes are: miscellaneous federal, Department of State Lands-Classified Forest Land and Classified Grazing Land, county and municipal, Montana Department of Fish, Wildlife and Parks, other state, forest industry, farmer-rancher, other private corporate, and other private individual.

#### Ownership group

Convenient groups of ownership classes. The groups are: State and other public, forest industry, and other private.

#### Poletimber stands

Stands at least 16.7 percent stocked with growing stock trees of which 50 percent or more of this stocking is in pole timber and/or sawtimber trees, and with pole timber stocking exceeding that of sawtimber.

#### Pole timber trees

Trees at least 5.0 inches in diameter at breast height but smaller than 9.0 inches for softwoods and 11.0 inches for hardwoods.

#### Potential growth

Or yield capability is defined as mean annual increment of growing stock attainable in fully stocked natural stands at the age of culmination of mean annual increment. When expressed in cubic feet of growing stock, unless specified otherwise, the volume figure includes all surviving live trees 1.0 inches d.b.h. and larger, for most tree species. See Brickell (1970) for further information.

#### Precommercial thinning

A thinning in which the cut trees are too small to be removed and utilized.

#### Productive-reserved forest land

Forest land sufficiently productive to qualify as commercial forest land, but withdrawn from timber utilization through statute, administrative designation, or exclusive use for Christmas-tree production.

#### Rotation

The period of years between establishment of a stand of timber and the time when it is considered ready for cutting regeneration.

#### Rotten trees

Live trees of commercial species that do not contain at least one 12-foot sawlog or two noncontiguous sawlogs, each 8 feet long or longer, now or prospectively and/or do not meet regional specifications for freedom from defect primarily because of rot; that is, when more than 50 percent of the cull volume in a tree is rotten.



#### Rough trees

- (1) Live trees of commercial species that do not contain at least one 12-foot sawlog or two noncontiguous sawlogs, each 8 feet long or longer, now or prospectively, and/or do not meet regional specifications for freedom from defect primarily because of roughness or poor form.
- (2) All live trees of noncommercial species.

#### Salvable dead

Standing and down dead trees 5.0 inches d.b.h. and larger and more than 50 percent sound on a cubic foot basis.

No defect    Tree has no rot, and no defect such as excessive sweep and crook.

Defect-mostly physical    Tree is more than 50 percent sound on a cubic-foot basis. Less than half the total volume loss is due to rot and more than half is due to such defects as excessive sweep and crook.

Defect-mostly rot    Tree is more than 50 percent sound on a cubic-foot basis. More than half of the total volume loss is due to rot and less than half is due to such defects as excessive sweep and crook. Tree or potential product sections are firm enough to hold together if handled.

#### Sanitation

Improving the health of a stand through intermediate cuttings which reduce the source of the insect or disease problem.

#### Saplings

Trees 1.0 inches to 4.0 inches in diameter at breast height.

#### Sawlog

A section of a tree stem of sufficient size to yield commercial size dimension lumber.

#### Sawtimber trees

Softwood trees which are 9.0 inches and larger and hardwood trees which are 11.0 inches and larger in diameter at breast height.

#### Sawtimber volume

Net volume in board feet of sawtimber trees of commercial species. Net volume equals gross volume less deduction for rot, sweep, crook, and other defects that affect use for lumber.

#### Scribner Rule

The common board-foot log rule used in determining volume of sawtimber in the Western states.

#### Seedlings

Live trees less than 1.0 inch in diameter at breast height.

#### Seedling-sapling stands

Stands at least 16.7 percent stocked with growing stock trees in which more than half of the stocking is saplings and/or seedlings.

#### Site Class

A classification of forest land in terms of inherent capacity to grow crops of industrial wood. Site classifications are based upon the mean annual growth of growing stock (not including thinnings) attainable in fully stocked stands at culmination of mean annual growth. Height-age relationships are usually used as indicators of the specified volume-site class.

#### Site index class

A measure of site productivity based upon the height of trees at a given base age. Site index classes are height classes represented by a graphed curve of height over age for each class.

#### Site trees

Trees measured for height and age, used to estimate site index.

#### Softwoods

Coniferous trees, usually evergreen, having needle or scale-like leaves.

#### Stand density

A quantitative measure of a stand in terms of square feet of basal area, number of trees, or volume per acre. It reflects the degree of crowding of stems within the area.

#### Stand-size class

A classification of forest land based on the class of growing stock trees on the area, that is, sawtimber, pole timber, or seedlings and saplings. (Note: Only those trees that contribute to no more than 16 percent of stocking at a plot point, based upon a 10-point location, will be considered in determining stand-size class).

#### State and other public ownership group

The ownership group that consists of state, county, municipal, and miscellaneous federal land.

#### State forest

Lands administered by the Department of State Lands that are managed as a unit.

#### State forest land

State owned land that is principally valuable for forest and watershed cover that is classified as forest and administered by the Department of State Lands.

#### State grazing land

State owned land that is principally valuable for forage production that is classified as grazing and administered by the Department of State Lands.

#### Stocking

Stocking is an effort to express the extent to which growing space is effectively utilized by present or potential growing-stock trees or commercial species. "Percent of stocking" is synonymous with



"percentage of growing space occupied" and means the ratio of actual stocking to full stocking for comparable sites and stands. Basal area is used as a basis for measuring stocking.

"Stocking percentages" express current area occupancy in relation to specified standards for full stocking based on number, size, and spacing of trees considered necessary to fully utilize the forest land.

Full utilization of the site is assumed to occur over a range of basal area. As an interim guide, 60 percent of the normal yield table values has been used to establish the lower limit of this range which represents full site occupancy. This is called 100-percent stocking. The upper limit of full stocking has been set at 133 percent. Sites with less than 100-percent stocking represent under-stocking with less than full site occupancy. Over-stocking is characterized by sites that have over 133 percent stocking.

#### Tertiary deposits

Rock and materials deposited in the period of geologic time previous to the current period, which ran from about 65 million to about 2.5 million years ago.

#### Tree class

A classification assigned to each live tree based on such physical characteristics as surface and internal defects, relative pole length, crown ratio and position, and damage sustained by the tree. (See also desirable tree, acceptable tree, rough tree, and rotten tree).

#### Tree size class

A classification of trees primarily according to diameter at breast height outside bark, including sawtimber trees, pole timber trees, saplings, and seedlings.

#### Unproductive forest land

Forest land incapable of producing 20 cubic feet per acre of industrial wood under natural conditions, because of adverse site conditions. (Note: Adverse conditions include sterile soils, dry climate, poor drainage, high elevation, steepness, and rockiness).

#### Variable radius plot

A plot on which a predetermined critical angle is projected from a central point, and swept in a full circle, to determine the basal area, tree count, and volume per unit of area. The radius of this plot is a function of tree basal area and is therefore variable.

#### Young-growth sawtimber stands

Sawtimber stands in which 50 percent or more of the stand is occupied by young-growth sawtimber trees.

#### Young-growth sawtimber trees

Sawtimber trees less than 100 years old.





MONTANA  
DEPARTMENT OF STATE LANDS  
DIVISION OF FORESTRY  
MISSOULA, MONTANA



1,000 copies of this public document were published at an estimated cost of \$5.11 per copy, for a total cost of \$5,112.15, which includes \$4,962.15 for printing and \$150.00 for distribution.